VPA01082 NEW PERMIT #

HD
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Tidewater Regional Office

VPA Permit Application for
Kuzzen's Mappsville North Packing Plant

2014

MSA, P.C.
5033 Rouse Drive, Virginia Beach, VA 23462-3708 • (757) 490-9264 • (757) 490-0634 [fax] • www.msaonline.com
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prev EC. Brokers & Packers in file 593 now VPA01082

Environmental Sciences • Planning • Surveying • Civil & Environmental Engineering • Landscape Architecture

February 19, 2014

RECEIVED – DEQ
FEB 26 2014
Tidewater Regional Office

Attn: Bob Smithson
Virginia Dept. of Environmental Quality
5636 Southern Boulevard
Virginia Beach, VA 23462

RE: VPA Permit Application
Kuzzens-Mappsville North Packing Plant
MSA Project #08719AO

Dear Mr. Smith:

Enclosed is the subject application and associated attachments. This facility, as you know, was owned by East Coast Brokers and Packers and was purchased by Kuzzens, Inc. Other permits are being transferred to the new owner as well. Planned operations will not be identical to previous operations for at least the upcoming season and this will become clear as you move through this application.

Should you have any questions or need additional information, please contact me at 490-9264 or email me at Morgan.evans@msaonline.com.

Sincerely,

Morgan Evans

Morgan Evans
Environmental Technician

MSA, P.C.
5033 Rouse Drive, Virginia Beach, VA 23462-3708
Office (757) 490-9264 • Fax (757) 490-0634
www.msaonline.com

March 25, 2014

Robert E. Smithson, Jr.
Virginia Dept. of Environmental Quality
5636 Southern Boulevard
Virginia Beach, VA 23462

HD
RECEIVED – DEQ
MAR 2 5 2014
Tidewater Regional Office

RE: Mappsville North Packing Plant
VPA Permit Application
MSA Project #08719AO

Dear Mr. Smithson:

We received your review comments (3/5/14) regarding the application for a permit to dispose wastewater at the above referenced facility. Enclosed for your review are the revised sections of the VPA Permit Application and additional information related to the comments. Each of the DEQ comments has been addressed as follows:

Form C, Section C-1

Page C-1.1. 2a. *Identify all potential crops involved (i.e. which vegetables to be washed/packaged). Any other pesticides/herbicides that might be used will also need to be identified on page C.1.7 (waste characterization).*

Response: Potatoes will be processed at this facility. Text in the application has been revised from "vegetagbles" to "potatoes".

Pages C.1.4 through C.1.7- *As indicated, data are from 2009. Recent data are required when it becomes available. A special condition will be included in the permit which requires analysis of parameters found in on these pages.*

Response: Noted.

Page C-1.3: *A waiver has not been requested for any parameters in section 4.a. for this permit application. Waivers are granted on a case by case basis and are not to be generically assumed. Provide rationale for each parameter requesting to be waived.*

Response: No waiver was assumed or requested in the initial application. Where rationale is presented in the revised application, we are requesting a parameter to be waived as non-applicable.

Page C-1.4: *Sodium should be present in this effluent. Provide data, or indicate that it will be provided when available.*

Response: Sodium containing substances will no longer be used at this processing facility.

Page C-1.7: *Parameters marked unknown concentration will either need to be identified or concentration marked "to be provided". Item 5: "gasing off free chlorine" has not been explained or source identified. A concentration and source for chlorine is also needed here or elsewhere in the application.*

Response: Noted. Reference to chlorine was relict from prior application for this facility when sodium hypochlorite was used as a disinfectant.

Form C, Section C-ll.

Page C-ll.2, Item#3: *Appendix ll: A complete description of agronomic practices has not been provided. Please reference the enclosure for direction.*

Response: The agronomic practices section provided in the original application has been revised as requested and enclosed in Appendix C.

Page C-ll.2, Item#3: *Appendix ll: Please provide a copy of a current, approved nutrient management plan (NMP). If one has not been developed/approved indicate when it will be available. It should show, but not be limited to nutrient management details for tall fescue grasses. We are particularly interested in discussions on sodium and copper residual levels in the field(s). Plan of action for problems (or potential problems) identified. Salts in irrigation water can be detrimental to plant growth if its concentration is too high, preventing water from being easily absorbed by the grass, causing drought-type symptoms. Tall Fescue is only moderately tolerant to salts. The plan should also recommend supplemental fertilizer in the summer to keep grasses healthy and viable, since the irrigation wastewater is generally nutrient poor. The plan will include, but not be limited to a discussion of PAN. The NMP should be approved by a certified nutrient mgt. planner.*

Response: Noted. A current nutrient management plan to at least include the above will be provided as soon as possible.

Page C-ll.2, Item#4: *Elaborate on the type of spray system used, it's adequacy, problems encountered with it in the past, spare parts available, back up procedures, if necessary, etc.*

Response: The older irrigation system will no longer be used. In its place will be irrigation by spray truck as explained in the Agronomic Practices documents (Appendix C).

Page C-ll.4, Item#10: *If the land application site is entirely owned by the applicant, the authorization to land apply document on page C-ll.5 is not applicable. Please explain why it is included.*

Response: The applicant is the owner of the spray field. This Item was mistakenly completed in the initial application and has been removed from the revised submission.

Page C-ll.2, Exhibit B: *A discussion on culls disposal has been completely omitted, but is indicated here in exhibit B. A separate map needs to indicate the cull field disposal site(s), acreage available, quantity and types of vegetable waste to be disposed of, soil types present at the site(s), and truck route, if applicable.*

Response: The permit being sought is for disposal of waste wash water onto an agricultural field and not the offsite disposal of culls. Nevertheless, a separate discussion on culls is provided in Appendix C. Culls are shown on the process line diagram in Figure 2; cull field location, soil types, and truck hauling routes are shown on Figures 6, 7, and 8.

Page C-ll.2, *Appendix V (acres required/site life) will need to be updated/revised when current data becomes available. Ex. sulfur, salt, carbon/nitrogen balances, etc.*

Response: Noted; calculations will be updated when data becomes available.

Appendix IV: *I note that the soils monitoring (2011) is lacking. Basically only nitrogen and phosphorous were analyzed for and it was only one sample which does not represent all soil types present (Munden?). No metals or, ex. calcium, ex. sodium, magnesium, etc. were analyzed. Potassium showed non-detect which shouldn't be.*

Response: The soil chemistry data provided was all that is available. It is likely that this data is limited due to a misinterpretation of the requirements table (C.II.6) that occurred during the previous permitting process. Knowing that the facility operation is seasonal, the table column denoted "infrequent" was likely considered applicable instead of the column denoted "wastewater". Nevertheless, soil from each major soil series at the spray field was recently sampled and the required data is included herein Appendix B.

Refer to application question C.ll.3 item 7 *that requires representative soil samples for each major soil type and for the soil parameters on page C.ll.6. Please address the additional soil sampling which is needed to complete the application. It does need to be done up front so that we can assess soils considerations.*

Response: Noted; completed. See response above.

Thank you very much for your assistance Bob. I realize that this application is coming late with respect to the upcoming operational season. We have done the best we could to get all the information to you as soon as possible and will continue that way during the permitting process. To the degree that you are able, we respectfully request an expedited review so that the business may operate this season since the crops are currently growing. There is a very short duration (eight weeks) to process the potatoes. Please understand we will provide whatever else you need to help you with your review. Should you have any questions or need additional information, please contact Morgan Evans or me at 757-490-9264.

Sincerely,

Charles H. Hall, P.G., Hydrogeologist
Director of Environmental Sciences

Copy: Kuzzens
Attachments: Application fee; application package

REC 4/30/14

Pacific Agricultural Laboratory

12505 N.W. Cornell Rd. • Portland, OR 97229-5651 • Ph 503.626.7943 • Fx 503.641.0644

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078

Report Number: P140341
Report Date: April 29, 2014
Client Project ID: 92197251

Analytical Report

Client Sample ID: Flume
Matrix: water

PAL Sample ID: P140341-01
Sample Date: 4/11/14

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: EPA 547 (HPLC-FLD)					
4/21/14	4/22/14	AMPA	Not Detected	10 ug/L	
4/21/14	4/22/14	Glyphosate	Not Detected	10 ug/L	
Method: EPA 630.1 (GC-FPD)					
4/18/14	4/18/14	Mancozeb	Not Detected	10 ug/L	
4/18/14	4/18/14	Maneb	Not Detected	10 ug/L	
4/18/14	4/18/14	Nabam	Not Detected	10 ug/L	
4/18/14	4/18/14	Thiram	Not Detected	10 ug/L	
4/18/14	4/18/14	Vapam	Not Detected	10 ug/L	
4/18/14	4/18/14	Zineb	Not Detected	10 ug/L	
4/18/14	4/18/14	Ziram	Not Detected	10 ug/L	
Method: Modified EPA 8270D (GC-MS SIM)					
4/16/14	4/28/14	Chlorothalonil	Not Detected	0.060 ug/L	
4/16/14	4/28/14	Fipronil	0.76 ug/L	0.060 ug/L	
4/16/14	4/28/14	Mefenoxam	Not Detected	0.060 ug/L	
4/16/14	4/28/14	Metolachlor	Not Detected	0.060 ug/L	
4/16/14	4/28/14	Metribuzin	Not Detected	0.060 ug/L	
Method: Modified EPA 8321B (HPLC-MS)					
4/16/14	4/21/14	Azoxystrobin	0.22 ug/L	0.12 ug/L	
4/16/14	4/21/14	Carfentrazone-ethyl	Not Detected	0.12 ug/L	
4/17/14	4/18/14	Clethodim	Not Detected	1.0 ug/L	
4/16/14	4/21/14	Cymoxanil	Not Detected	0.12 ug/L	
4/16/14	4/21/14	Imidacloprid	0.32 ug/L	0.12 ug/L	
4/16/14	4/21/14	Novaluron	Not Detected	0.12 ug/L	
4/16/14	4/21/14	Oxamyl	Not Detected	0.12 ug/L	

Rick Jordan, Laboratory Manager

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Huntersville, NC 28078

Report Number: P140341
Report Date: April 29, 2014
Client Project ID: 92197251

Quality Assurance

Method Blank Data **Matrix:** water

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/16/14	4/21/14	4041601-BLK1	Azoxystrobin	Not Detected	< 0.12 ug/L	
4/16/14	4/21/14	4041601-BLK1	Carfentrazone-ethyl	Not Detected	< 0.12 ug/L	
4/16/14	4/28/14	4041601-BLK1	Chlorothalonil	Not Detected	< 0.060 ug/L	
4/16/14	4/21/14	4041601-BLK1	Cymoxanil	Not Detected	< 0.12 ug/L	
4/16/14	4/28/14	4041601-BLK1	Fipronil	Not Detected	< 0.060 ug/L	
4/16/14	4/21/14	4041601-BLK1	Imidacloprid	Not Detected	< 0.12 ug/L	
4/16/14	4/28/14	4041601-BLK1	Mefenoxam	Not Detected	< 0.060 ug/L	
4/16/14	4/28/14	4041601-BLK1	Metolachlor	Not Detected	< 0.060 ug/L	
4/16/14	4/28/14	4041601-BLK1	Metribuzin	Not Detected	< 0.060 ug/L	
4/16/14	4/21/14	4041601-BLK1	Novaluron	Not Detected	< 0.12 ug/L	
4/16/14	4/21/14	4041601-BLK1	Oxamyl	Not Detected	< 0.12 ug/L	

Method Blank Data **Matrix:** water

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/17/14	4/18/14	4041701-BLK1	Clethodim	Not Detected	< 1.0 ug/L	

Method Blank Data **Matrix:** water

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/18/14	4/18/14	4041802-BLK1	Mancozeb	Not Detected	< 10 ug/L	
4/18/14	4/18/14	4041802-BLK1	Maneb	Not Detected	< 10 ug/L	
4/18/14	4/18/14	4041802-BLK1	Nabam	Not Detected	< 10 ug/L	
4/18/14	4/18/14	4041802-BLK1	Thiram	Not Detected	< 10 ug/L	
4/18/14	4/18/14	4041802-BLK1	Vapam	Not Detected	< 10 ug/L	
4/18/14	4/18/14	4041802-BLK1	Zineb	Not Detected	< 10 ug/L	
4/18/14	4/18/14	4041802-BLK1	Ziram	Not Detected	< 10 ug/L	

Method Blank Data **Matrix:** water

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/21/14	4/22/14	4042110-BLK1	AMPA	Not Detected	< 10 ug/L	
4/21/14	4/22/14	4042110-BLK1	Glyphosate	Not Detected	< 10 ug/L	

Rick Jordan, Laboratory Manager

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Pace Analytical Services, Inc.
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Huntersville, NC 28078

Report Number: P140341
Report Date: April 29, 2014
Client Project ID: 92197251

Blank Spike Data **Matrix:** water

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/16/14	4/21/14	4041601-BS1	Azoxystrobin	104	52-138	
4/16/14	4/21/14	4041601-BSD1	Azoxystrobin	90	52-138	
4/16/14	4/21/14	4041601-BS1	Carfentrazone-ethyl	107	34-171	
4/16/14	4/21/14	4041601-BSD1	Carfentrazone-ethyl	103	34-171	
4/16/14	4/28/14	4041601-BS1	Chlorothalonil	102	60-140	
4/16/14	4/28/14	4041601-BSD1	Chlorothalonil	88	60-140	
4/16/14	4/21/14	4041601-BS1	Cymoxanil	81	60-140	
4/16/14	4/21/14	4041601-BSD1	Cymoxanil	80	60-140	
4/16/14	4/28/14	4041601-BS1	Fipronil	92	60-140	
4/16/14	4/28/14	4041601-BSD1	Fipronil	91	60-140	
4/16/14	4/21/14	4041601-BS1	Imidacloprid	91	60-140	
4/16/14	4/21/14	4041601-BSD1	Imidacloprid	95	60-140	
4/16/14	4/28/14	4041601-BS1	Mefenoxam	95	60-140	
4/16/14	4/28/14	4041601-BSD1	Mefenoxam	95	60-140	
4/16/14	4/28/14	4041601-BS1	Metolachlor	95	60-140	
4/16/14	4/28/14	4041601-BSD1	Metolachlor	95	60-140	
4/16/14	4/28/14	4041601-BS1	Metribuzin	95	60-140	
4/16/14	4/28/14	4041601-BSD1	Metribuzin	89	60-140	
4/16/14	4/21/14	4041601-BS1	Novaluron	90	60-140	
4/16/14	4/21/14	4041601-BSD1	Novaluron	92	60-140	
4/16/14	4/21/14	4041601-BS1	Oxamyl	66	60-140	
4/16/14	4/21/14	4041601-BSD1	Oxamyl	68	60-140	

Blank Spike Data **Matrix:** water

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/17/14	4/17/14	4041701-BS1	Clethodim	69	60-140	
4/17/14	4/17/14	4041701-BSD1	Clethodim	68	60-140	

Blank Spike Data **Matrix:** water

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/18/14	4/18/14	4041802-BS1	Carbon Disulfide	106	24-188	
4/18/14	4/18/14	4041802-BSD1	Carbon Disulfide	105	24-188	

Rick Jordan, Laboratory Manager

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Huntersville, NC 28078

Report Number: P140341
Report Date: April 29, 2014
Client Project ID: 92197251

Blank Spike Data **Matrix:** water

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/21/14	4/22/14	4042110-BS1	AMPA	91	64-132	
4/21/14	4/22/14	4042110-BSD1	AMPA	98	64-132	
4/21/14	4/22/14	4042110-BS1	Glyphosate	98	65-133	
4/21/14	4/22/14	4042110-BSD1	Glyphosate	109	65-133	

Analyte Information

Method: EPA 547 (HPLC-FLD)

AMPA is the primary metabolite of Glyphosate. Glyphosate is quantitated as the free acid.

Method: EPA 630.1 (GC-FPD)

This is a presumptive method for thiocarbamates. Residues are identified as carbon disulfide.

Rick Jordan, Laboratory Manager

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CERTIFICATIONS

Project: Virginia Farm
Pace Project No.: 92197241

Ormond Beach Certification IDs
8 East Tower Circle, Ormond Beach, FL 32174
Alabama Certification #: 41320
Arizona Certification #: AZ0735
Colorado Certification: FL NELAC Reciprocity
Connecticut Certification #: PH-0216
Delaware Certification: FL NELAC Reciprocity
Florida Certification #: E83079
Georgia Certification #: 955
Guam Certification: FL NELAC Reciprocity
Hawaii Certification: FL NELAC Reciprocity
Illinois Certification #: 200068
Indiana Certification: FL NELAC Reciprocity
Kansas Certification #: E-10383
Kentucky Certification #: 90050
Louisiana Certification #: FL NELAC Reciprocity
Louisiana Environmental Certificate #: 05007
Maine Certification #: FL01264
Maryland Certification: #346
Massachusetts Certification #: M-FL1264
Michigan Certification #: 9911
Mississippi Certification: FL NELAC Reciprocity
Montana Certification #: Cert 0074
Nebraska Certification: NE-OS-28-14
Nevada Certification: FL NELAC Reciprocity
New Hampshire Certification #: 2958
New Jersey Certification #: FL765
New York Certification #: 11608
North Carolina Environmental Certificate #: 667
North Carolina Certification #: 12710
Pennsylvania Certification #: 68-00547
Puerto Rico Certification #: FL01264
South Carolina Certification: #96042001
Tennessee Certification #: TN02974
Texas Certification: FL NELAC Reciprocity
US Virgin Islands Certification: FL NELAC Reciprocity
Virginia Environmental Certification #: 460165
Washington Certification #: C955
West Virginia Certification #: 9962C
Wisconsin Certification #: 399079670
Wyoming (EPA Region 8): FL NELAC Reciprocity

REPORT OF LABORATORY ANALYSIS

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(704)875-9092

SAMPLE ANALYTE COUNT

Project: Virginia Farm
Pace Project No.: 92197241

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
92197241001	**Flume**	EPA 625	EAO	8	PASI-O
		EPA 624	JLR	7	PASI-O

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(704)875-9092

ANALYTICAL RESULTS

Project: Virginia Farm
Pace Project No.: 92197241

Sample: Flume **Lab ID: 92197241001** Collected: 04/11/14 09:40 Received: 04/11/14 15:42 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
625 MSSV	Analytical Method: EPA 625 Preparation Method: EPA 625							
bis(2-Ethylhexyl)phthalate	ND	ug/L	4.9	1	04/18/14 08:00	04/22/14 01:36	117-81-7	
Naphthalene	ND	ug/L	4.9	1	04/18/14 08:00	04/22/14 01:36	91-20-3	
Surrogates								
Nitrobenzene-d5 (S)	48	%	37.3-107.7	1	04/18/14 08:00	04/22/14 01:36	4165-60-0	
2-Fluorobiphenyl (S)	57	%	35.3-102.4	1	04/18/14 08:00	04/22/14 01:36	321-60-8	
Terphenyl-d14 (S)	67	%	50.1-115.1	1	04/18/14 08:00	04/22/14 01:36	1718-51-0	
Phenol-d6 (S)	17	%	10-47.1	1	04/18/14 08:00	04/22/14 01:36	13127-88-3	
2-Fluorophenol (S)	27	%	16.3-59.8	1	04/18/14 08:00	04/22/14 01:36	367-12-4	
2,4,6-Tribromophenol (S)	72	%	54.2-114.4	1	04/18/14 08:00	04/22/14 01:36	118-79-6	
624 Volatile Organics	Analytical Method: EPA 624							
Acrylonitrile	ND	ug/L	10.0	1		04/25/14 13:52	107-13-1	
Chloroform	ND	ug/L	1.0	1		04/25/14 13:52	67-66-3	
Dibromochloromethane	ND	ug/L	0.50	1		04/25/14 13:52	124-48-1	
Ethylbenzene	ND	ug/L	1.0	1		04/25/14 13:52	100-41-4	
Surrogates								
4-Bromofluorobenzene (S)	90	%	71-111	1		04/25/14 13:52	460-00-4	
Toluene-d8 (S)	98	%	77-116	1		04/25/14 13:52	2037-26-5	
1,2-Dichloroethane-d4 (S)	106	%	79-123	1		04/25/14 13:52	17060-07-0	

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Pace Analytical Services, Inc.
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(704)875-9092

QUALITY CONTROL DATA

Project: Virginia Farm
Pace Project No.: 92197241

QC Batch: MSV/11473 Analysis Method: EPA 624
QC Batch Method: EPA 624 Analysis Description: 624 MSV
Associated Lab Samples: 92197241001

METHOD BLANK: 887530 Matrix: Water
Associated Lab Samples:

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Acrylonitrile	ug/L	ND	10.0	04/25/14 13:27	
Chloroform	ug/L	ND	1.0	04/25/14 13:27	
Dibromochloromethane	ug/L	ND	0.50	04/25/14 13:27	
Ethylbenzene	ug/L	ND	1.0	04/25/14 13:27	
1,2-Dichloroethane-d4 (S)	%	106	79-123	04/25/14 13:27	
4-Bromofluorobenzene (S)	%	92	71-111	04/25/14 13:27	
Toluene-d8 (S)	%	98	77-116	04/25/14 13:27	

LABORATORY CONTROL SAMPLE: 887531

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Acrylonitrile	ug/L	200	191	96	60-146	
Chloroform	ug/L	20	19.7	98	51-138	
Dibromochloromethane	ug/L	20	19.1	96	35-155	
Ethylbenzene	ug/L	20	20.3	102	37-162	
1,2-Dichloroethane-d4 (S)	%			95	79-123	
4-Bromofluorobenzene (S)	%			98	71-111	
Toluene-d8 (S)	%			100	77-116	

MATRIX SPIKE SAMPLE: 887532

Parameter	Units	92197241001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Acrylonitrile	ug/L	ND	200	193	97	60-146	H1
Chloroform	ug/L	ND	20	18.9	95	51-138	H1
Dibromochloromethane	ug/L	ND	20	18.9	94	35-155	H1
Ethylbenzene	ug/L	ND	20	19.3	96	37-162	H1
1,2-Dichloroethane-d4 (S)	%				100	79-123	
4-Bromofluorobenzene (S)	%				99	71-111	
Toluene-d8 (S)	%				99	77-116	

SAMPLE DUPLICATE: 887533

Parameter	Units	35134467001 Result	Dup Result	RPD	Qualifiers
Acrylonitrile	ug/L	5.0U	ND		
Chloroform	ug/L	7.4	7.3	2	
Dibromochloromethane	ug/L	0.25U	ND		
Ethylbenzene	ug/L	0.50U	ND		
1,2-Dichloroethane-d4 (S)	%	115	115	.1	

REPORT OF LABORATORY ANALYSIS

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Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

QUALITY CONTROL DATA

Project: Virginia Farm
Pace Project No.: 92197241

SAMPLE DUPLICATE: 887533

Parameter	Units	35134467001 Result	Dup Result	RPD	Qualifiers
4-Bromofluorobenzene (S)	%	95	98	3	
Toluene-d8 (S)	%	99	96	3	

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: Virginia Farm
Pace Project No.: 92197241

QC Batch: OEXT/16969
QC Batch Method: EPA 625
Analysis Method: EPA 625
Analysis Description: 625 MSS
Associated Lab Samples: 92197241001

METHOD BLANK: 881527 Matrix: Water
Associated Lab Samples: 92197241001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
bis(2-Ethylhexyl)phthalate	ug/L	ND	5.0	04/21/14 22:52	
Naphthalene	ug/L	ND	5.0	04/21/14 22:52	
2,4,6-Tribromophenol (S)	%	69	54.2-114.4	04/21/14 22:52	
2-Fluorobiphenyl (S)	%	62	35.3-102.4	04/21/14 22:52	
2-Fluorophenol (S)	%	28	16.3-59.8	04/21/14 22:52	
Nitrobenzene-d5 (S)	%	52	37.3-107.7	04/21/14 22:52	
Phenol-d6 (S)	%	22	10-47.1	04/21/14 22:52	
Terphenyl-d14 (S)	%	84	50.1-115.1	04/21/14 22:52	

LABORATORY CONTROL SAMPLE: 881528

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
bis(2-Ethylhexyl)phthalate	ug/L	50	40.0	80	10-158	
Naphthalene	ug/L	50	30.8	62	21-133	
2,4,6-Tribromophenol (S)	%			79	54.2-114.4	
2-Fluorobiphenyl (S)	%			64	35.3-102.4	
2-Fluorophenol (S)	%			32	16.3-59.8	
Nitrobenzene-d5 (S)	%			64	37.3-107.7	
Phenol-d6 (S)	%			22	10-47.1	
Terphenyl-d14 (S)	%			77	50.1-115.1	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 881634 881635

Parameter	Units	35134379001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Qual
bis(2-Ethylhexyl)phthalate	ug/L	0.87U	100	100	82.0	82.7	82	83	10-158	.9	
Naphthalene	ug/L	0.85U	100	100	64.6	61.4	65	61	21-133	5	
2,4,6-Tribromophenol (S)	%						83	77	54.2-114		
2-Fluorobiphenyl (S)	%						65	64	35.3-102		
2-Fluorophenol (S)	%						41	40	16.3-59.		
Nitrobenzene-d5 (S)	%						63	62	37.3-107		
Phenol-d6 (S)	%						34	32	10-47.1		
Terphenyl-d14 (S)	%						75	75	50.1-115		

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QUALIFIERS

Project: Virginia Farm
Pace Project No.: 92197241

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PRL - Pace Reporting Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Acid preservation may not be appropriate for 2-Chloroethylvinyl ether, Styrene, and Vinyl chloride.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

LABORATORIES

PASI-O Pace Analytical Services - Ormond Beach

ANALYTE QUALIFIERS

H1 Analysis conducted outside the EPA method holding time.

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: Virginia Farm
Pace Project No.: 92197241

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
92197241001	**Flume**	EPA 625	OEXT/16969	EPA 625	MSSV/6097
92197241001	**Flume**	EPA 624	MSV/11473		

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Pace Analytical	Document Name: Sample Condition Upon Receipt Form Document No.: F-FL-C-007 rev. 05	Document Revised: October 9, 2013 Issuing Authorities: Pace Florida Quality Office

Sample Condition Upon Receipt Form (SCUR)

Table Number: _____

Client Name: Campbell Hana Project #: _____

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☑ Client ☐ Commercial ☐ Pace ☐ Other: _____

Tracking # _____

Custody Seal on Cooler/Box Present: ☑ yes ☐ no Seals Intact: ☑ yes ☐ no

Packing Material: ☐ Bubble Wrap ☑ Bubble Bags ☐ None ☐ Other _____

Thermometer Used T-165 Type of Ice: ☑ Wet ☐ Blue ☐ None

Cooler Temperature °C 5.8 (Visual) -0.1 (Correction Factor) 5.7 (Actual)
4.9 -0.1 4.8

(Temp should be above freezing to 6°C). If below 0°C, then was sample frozen? ☐ Yes ☐ No

Date and initials of person examining contents: 4-11-14

Receipt of samples satisfactory: ☐ Yes ☐ No

Rush TAT requested on COC:

If yes, then all conditions below were met:	If no, then mark box & describe issue (use comments area if necessary):
Chain of Custody Present	☐
Chain of Custody Filled Out	☐
Relinquished Signature & Sampler Name COC	☐
Samples Arrived within Hold Time	☐
Sufficient Volume	☐
Correct Containers Used	☐
Containers Intact	☐
Sample Labels match COC (sample IDs & date/time of collection)	☐ No Labels: ☐ No Time/Date on Labels: ☐
All containers needing preservation are found to be in compliance with EPA recommendation.	☐
No Headspace in VOA Vials (>6mm):	☐

Client Notification/ Resolution:

Person Contacted: Charles Hall Date/Time: 4-14-14

Comments/ Resolution (use back for additional comments): We can't analyze for the compounds requested by 1668, 8141, or 8082. We are subbing those out. We won't have results for benzeneacetate, pyrazinedilium dibromide, and 2-pyridinesulfonamide.

Project Manager Review: AMB / TMP Date: 4-14-14 | 4-14-14

Finished Product Information Only

F.P. Sample ID: _____

Production Code: _____

Date/Time Opened: _____

Number of Unopened Bottles Remaining: _____

Extra Sample in Shed: Yes No

Size & Qty of Bottles Received

_____ x 5 Gal
_____ x 2.5 Gal
_____ x 1 Gal
_____ x 1 Liter
_____ x 500 mL
_____ x 250 mL
_____ x Other: _____

92197241

Pace Analytical
www.pacelabs.com

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: of 1774990

Section A Required Client Information:	Section B Required Project Information:	Section C Invoice Information:
Company: CAMPBELL FARMS	Report To: JIM CORNELLIE	Attention:
Address: 15111 HWY. 17 EAST GRAFTON, ND 58237	Copy To:	Company Name:
Email To: jim@tricampbellfarms.com	Purchase Order No.:	Address:
Phone: 701-335-9255 Fax: 701-352-2008	Project Name: VIRGINIA FARM	Pace Quote Reference:
Requested Due Date/TAT:	Project Number:	Pace Project Manager:
		Pace Profile #: 35556-14

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☐ OTHER _____

Site Location STATE: _____

Section D Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Matrix Codes (MATRIX / CODE): Drinking Water DW; Water WT; Waste Water WW; Product P; Soil/Solid SL; Oil OL; Wipe WP; Air AR; Tissue TS; Other OT

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COMPOSITE START TIME	COMPOSITE END/GRAB DATE	COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Y/N	Analysis Test: 624	625	608	9251	9041	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	FLUME			—	—	4/11/14	0940		22/6				6						X	X	X	X	X		92197241 (01)
2																									
3																									
4																									
5																									
6																									
7																									
8																									
9																									
10																									
11																									
12																									

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS: Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
Empty Cooler	[signature] Trace	4/10/14	1545	[signature] Miller	4/10/14	1545				
	[signature]	4/11/14	1542	[signature] / PACE	4-11-14	1542	5.7 T-165	Y	Y	Y

ORIGINAL

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:

SIGNATURE of SAMPLER: DATE Signed (MM/DD/YY):

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

PESTICIDE INFO

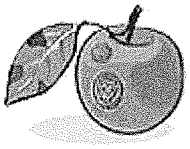
azoxystrobin

ALWAYS READ AND FOLLOW THE LABEL

Information on this page is not to be substituted for label directions

Active Ingredient (a.i.):
azoxystrobin

Target Pest Category:
fungicide



Examples of Trade Names:
Quadris, Heritage, Abound

Chemical Family:
Azoxystrobin is in the chemical family of Strobilurins. They are based on naturally occurring antifungal compounds in certain wood-decaying mushrooms.

What it is:
Azoxystrobin is a broad spectrum fungicide with protectant, curative, eradicant and systemic properties.

Types of Formulation:
solid, free flowing granules, wettable granule

How it works/Mode of Action:
Azoxystrobin is a systemic fungicide. It is absorbed through the roots and translocated in the xylem to the stems and leaves, or through leaf surfaces to the leaf tips and growing edges. The mode of action is by inhibition of mitochondrial respiration in fungi. It inhibits spore germination, mycelial growth, and spore production of fungi. Azoxystrobin is active at very low doses against a wide range of fungal pathogens.

Toxicity based on pure active ingredient:

Species	LD_{50}/LC_{50}	Relative Toxicity*
Mammal (rat)	LD_{50} Oral : >5000 mg/kg	Slightly toxic
	LD_{50} Dermal: >2000 mg/kg	Slightly toxic
Bird (quail)	LD_{50}: >2000 mg/kg	Practically non toxic
Bees (honeybees)	LD_{50}: >200 µg/bee	Practically non toxic
Fish (trout) (96 hour)	LC_{50}: 0.47 mg/L	Highly toxic
Worms (earth) (14 days)	LC_{50} : 283 mg/kg	-

*For description of relative toxicity categories please click here.

What it controls:
Controls foliar and soil-borne diseases including downy and powdery mildew, early and late blight, and pathogens *Sclerotinia, Alternaria, Ascochyta*, *Pythium*, and *Rhizoctonia* on many crops. In Canada, crops that may be treated with azoxystrobin include beans, peas, lentils, chickpea, canola, ginseng, potato, field tomato, hazelnuts, grains, grapes, leafy vegetables, daylilies and turf. Note: the specific crop-disease combination must be on the label.

Application Timing:
Refer to the label for detailed instructions on rates, application timing and technique for the specific crop and disease.

BRITISH COLUMBIA
Ministry of Agriculture and Lands

Mixing Instructions:

- Maintain agitation while spraying. If the spray mixture is left to stand for a long period (i.e. overnight), vigorous agitation will be required to re-suspend the fungicide.
- Stable in water at pH 5, 7 & 9, at 25 °C.

Application Tips:

- AVOID SPRAY DRIFT. Azoxystrobin has been shown to be extremely phytotoxic to certain apple and crabapple varieties and should not be applied where there is the possibility of spray drift reaching apple or crabapple trees.
- Do not apply through irrigation equipment.
- Do not apply by air.

Storage:

- Store in tightly closed **original** container.
- Store in a cool, dry, well ventilated area away from feed and foodstuffs, and out of reach of children and animals.
- Keep away from fire, open flame, or other sources of heat.

Applicator Safety and Re-entry:

- Do not re-enter fields until residues have dried.

Environmental Considerations:

- Azoxystrobin is toxic to fish and aquatic organisms. Observe buffer zones specified on the label to prevent drift or runoff into aquatic habitats.
- It is moderately persistent in soil, with a half-life of 1 to 4 weeks, or up to 7 weeks in anaerobic (flooded) soils.
- Azoxystrobin may present a leaching risk to groundwater. Therefore carefully manage irrigation.
- It is not harmful to honeybees, beneficial insects, earthworms or birds.
- Do not graze or feed clippings from treated areas to animals.

Resistance Management:

- Azoxystrobin is a Group 11 fungicide.
- Do not apply more than two consecutive applications of azoxystrobin or any other fungicide in the same group, in a season.
- Please check the label for more information on preventing resistance.
- Re-application intervals are dependant on the crop being treated. Refer to the product label.

Integrated Pest Management:

- Cultural practices such as canopy management and removal of overwintered plant debris should be integrated with the use of fungicides to reduce disease incidence.
- Under field conditions at field application rates, azoxystrobin is harmless to non-target organisms, including predatory mites and bugs, spiders, lacewings, hoverfly, ladybird, carabid beetle, parasitoid wasps and bees.

Unique Characteristics/Special Instructions:

- Azoxystrobin is very toxic to Macintosh apple trees and any apple varieties derived from Macintosh. Injury to crabapples has also been reported.

Pesticide Labels:

- To find labels for pesticides registered in Canada, please link to the Pest Management Regulatory Agency (PMRA) label search web page:

http://www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php

Last Updated: January 2009

IMIDACLOPRID
TECHNICAL FACT SHEET

npic
NATIONAL PESTICIDE INFORMATION CENTER
1.800.858.7378

NPIC Technical Fact Sheets provide information that is complex and intended for individuals with a scientific background and/or familiarity with toxicology and risk assessment. This document is intended to promote informed decision-making. Please refer to the General Fact Sheet for less technical information.

Chemical Class and Type:

- Imidacloprid is a neonicotinoid insecticide in the chloronicotinyl nitroguanidine chemical family.[1,2] The International Union of Pure and Applied Chemistry (IUPAC) name is 1-(6-chloro-3-pyridylmethyl)-N-nitroimidazolidin-2-ylideneamine and the Chemical Abstracts Service (CAS) registry number is 138261-41-3.[2]

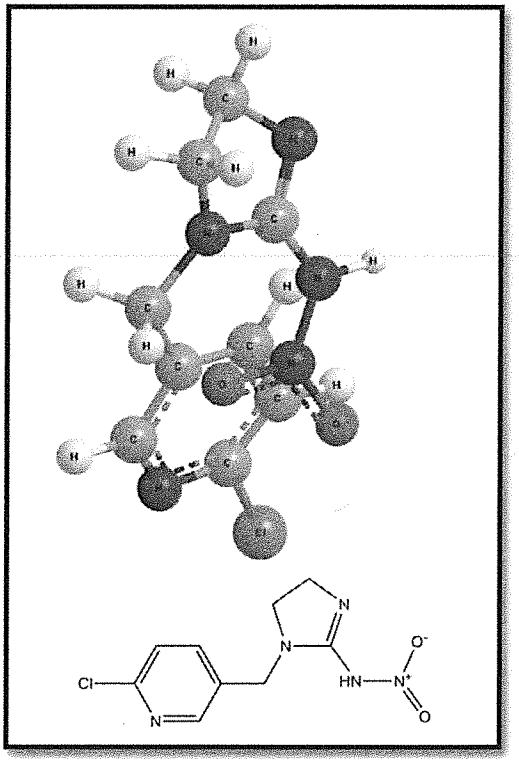
Laboratory Testing: Before pesticides are registered by the U.S. EPA, they must undergo laboratory testing for short-term (acute) and long-term (chronic) health effects. Laboratory animals are purposely given high enough doses to cause toxic effects. These tests help scientists judge how these chemicals might affect humans, domestic animals, and wildlife in cases of overexposure.

- Neonicotinoid insecticides are synthetic derivatives of nicotine, an alkaloid compound found in the leaves of many plants in addition to tobacco.[3,4,5]
- Imidacloprid was first registered for use in the U.S. by the United States Environmental Protection Agency (U.S. EPA) in 1994.[6] See the text box on **Laboratory Testing**.

Physical / Chemical Properties:

- Imidacloprid is made up of colorless crystals with a slight but characteristic odor.[2]
- Vapor pressure[7]: 3×10^{-12} mmHg at 20 °C
- Octanol-Water Partition Coefficient (log K_{ow})[2]: 0.57 at 21 °C
- Henry's constant[2]: 1.7×10^{-10} Pa·m³/mol
- Molecular weight[2]: 255.7 g/mol
- Solubility (water)[2]: 0.61 g/L at 20 °C
- Soil Sorption Coefficient (K_{oc})[8,9]: 156-960, mean values 249-336

Molecular Structure - Imidacloprid



Uses:

- Imidacloprid is used to control sucking insects, some chewing insects including termites, soil insects, and fleas on pets. In addition to its topical use on pets, imidacloprid may be applied to structures, crops, soil, and as a seed treatment.[2,10] Uses for individual products containing imidacloprid vary widely. Always read and follow the label when applying pesticide products.
- Signal words for products containing imidacloprid may range from Caution to Danger. The signal word reflects the combined toxicity of the active ingredient and other ingredients in the product. See the pesticide label on the product and refer to the NPIC fact sheets on ***Signal Words*** and ***Inert or "Other" Ingredients***.
- To find a list of products containing imidacloprid which are registered in your state, visit the website http://npic.orst.edu/reg/state_agencies.html and search by "active ingredient."

Mode of Action:

Target Organisms

- Imidacloprid is designed to be effective by contact or ingestion.[2] It is a systemic insecticide that translocates rapidly through plant tissues following application.[2,10]
- Imidacloprid acts on several types of post-synaptic nicotinic acetylcholine receptors in the nervous system.[11,12] In insects, these receptors are located only within the central nervous system. Following binding to the nicotinic receptor, nerve impulses are spontaneously discharged at first, followed by failure of the neuron to propagate any signal.[13,14] Sustained activation of the receptor results from the inability of acetylcholinesterases to break down the pesticide.[12] This binding process is irreversible.[5]

Non-Target Organisms

- Imidacloprid's mode of action is similar on target and non-target beneficial insects including honeybees, predatory ground beetles and parasitoid wasps.[10] However, imidacloprid is ineffective against spider mites and nematodes.[2]
- Mammalian nicotinic receptors are made up of a number of subtypes[14] In contrast to insects, these receptors are present at neuromuscular junctions as well as in the central nervous system.[14] However, the binding affinity of imidacloprid at the nicotinic receptors in mammals is much less than that of insect nicotinic receptors.[15] This appears to be true of other vertebrate groups including birds.[16,17]
- The blood-brain barrier in vertebrates blocks access of imidacloprid to the central nervous system, reducing its toxicity.[14]

Acute Toxicity:

Oral

- Imidacloprid is moderately toxic if ingested.[18] Oral LD_{50} values in rats were estimated to be 450 mg/kg for both sexes in one study and 500 and 380 mg/kg in males and females, respectively in another study.[2,19] In mice, LD_{50} values were estimated at 130 mg/kg for males and 170 mg/kg for females.[19,20] See the text boxes on **Toxicity Classification** and **LD_{50}/LC_{50}**.

LD_{50}/LC_{50}: A common measure of acute toxicity is the lethal dose (LD_{50}) or lethal concentration (LC_{50}) that causes death (resulting from a single or limited exposure) in 50 percent of the treated animals. LD_{50} is generally expressed as the dose in milligrams (mg) of chemical per kilogram (kg) of body weight. LC_{50} is often expressed as mg of chemical per volume (e.g., liter (L)) of medium (i.e., air or water) the organism is exposed to. Chemicals are considered highly toxic when the LD_{50}/LC_{50} is small and practically non-toxic when the value is large. However, the LD_{50}/LC_{50} does not reflect any effects from long-term exposure (i.e., cancer, birth defects or reproductive toxicity) that may occur at levels below those that cause death.

Dermal

- Imidacloprid is very low in toxicity via dermal exposure.[18] The dermal LD_{50} in rats was estimated at greater than 5000 mg/kg.[2,19]
- Researchers did not observe eye or skin irritation in rabbits.[19,20] Imidacloprid is not considered a skin sensitizer[20] although reports of hypersensitivity in skin following exposure to imidacloprid have been reported in companion animals.[1]

Inhalation

- Imidacloprid is variable in toxicity if inhaled. The inhalation LC_{50} was estimated to be greater than 5323 mg/m^3 for dust and 69 mg/m^3 for aerosol exposure in rats.[2,20] Imidacloprid dust is considered slightly toxic but the aerosol form is highly toxic[18]

Signs of Toxicity - Animals

- Salivation and vomiting have been reported following oral exposure.[1,6] Very high oral exposures may lead to lethargy, vomiting, diarrhea, salivation, muscle weakness and ataxia, which are all indicative of imidacloprid's action on nicotinic receptors.[1] Other signs of exposure at high doses are uncoordinated gait, tremors, and reduced activity.[20]

TOXICITY CLASSIFICATION - IMIDACLOPRID

	High Toxicity	Moderate Toxicity	Low Toxicity	Very Low Toxicity
Acute Oral LD_{50}	Up to and including 50 mg/kg (≤ 50 mg/kg)	**Greater than 50 through 500 mg/kg (> 50 – 500 mg/kg)**	Greater than 500 through 5000 mg/kg (> 500 – 5000 mg/kg)	Greater than 5000 mg/kg (> 5000 mg/kg)
Inhalation LC_{50}	**Up to and including 0.05 mg/L (≤ 0.05 mg/L) (aerosol)**	Greater than 0.05 through 0.5 mg/L (>0.05 – 0.5 mg/L)	Greater than 0.5 through 2.0 mg/L (> 0.5 – 2.0 mg/L)	**Greater than 2.0 mg/L (> 2.0 mg/L) (dust)**
Dermal LD_{50}	Up to and including 200 mg/kg (≤ 200 mg/kg)	Greater than 200 through 2000 mg/kg (> 200 - 2000 mg/kg)	Greater than 2000 through 5000 mg/kg (>2000 – 5000 mg/kg)	**Greater than 5000 mg/kg (> 5000 mg/kg)**
Primary Eye Irritation	Corrosive (irreversible destruction of ocular tissue) or corneal involvement or irritation persisting for more than 21 days	Corneal involvement or other eye irritation clearing in 8 – 21 days	Corneal involvement or other eye irritation clearing in 7 days or less	**Minimal effects clearing in less than 24 hours**
Primary Skin Irritation	Corrosive (tissue destruction into the dermis and/or scarring)	Severe irritation at 72 hours (severe erythema or edema)	Moderate irritation at 72 hours (moderate erythema)	**Mild or slight irritation at 72 hours (no irritation or erythema)**

The highlighted boxes reflect the values in the "Acute Toxicity" section of this fact sheet. Modeled after the U.S. Environmental Protection Agency, Office of Pesticide Programs, Label Review Manual, Chapter 7: Precautionary Labeling

- Hypersensitivity reactions in skin have been reported following dermal applications of products containing imidacloprid.[1]
- Onset of signs of toxicity is rapid following acute exposure. In rats, clinical signs of intoxication occurred within 15 minutes of oral exposure.[14,21] Signs of toxicity disappear rapidly, with most resolving within 24 hours of the exposure. Lacrimation and urine staining may persist for up to four days after exposure to some neonicotinoids. Death occurred within 24 hours following administration of lethal doses.[21]
- Neither persistent neurotoxic effects nor effects with a delayed onset have been reported for imidacloprid.[21]

Signs of Toxicity - Humans

- Three case reports of attempted suicides described signs of toxicity including drowsiness, dizziness, vomiting, disorientation, and fever.[22,23,24] In two of these cases, the authors concluded that the other ingredients in the formulated product ingested by the victims were more likely to account for many of the observed signs.[22,23]
- A 69-year-old woman ingested a formulated product containing 9.6% imidacloprid in N-methyl pyrrolide solution. The woman suffered severe cardiac toxicity and death 12 hours after the exposure.[25] Signs of toxicity soon after the ingestion included disorientation, sweating, vomiting, and increased heart and respiratory rates.[25]
- A 24-year-old man who accidentally inhaled a pesticide containing 17.8% imidacloprid while working on his farm was disoriented, agitated, incoherent, sweating and breathless following the exposure.[26]
- Pet owners have reported contact dermatitis following the use of veterinary products containing imidacloprid on their pets.[19]
- Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to discuss an incident with the National Pesticide Information Center, please call 1-800-858-7378.

Chronic Toxicity:

Animals

- Rats consumed imidacloprid in their diet for three months at doses of 14, 61, and 300 mg/kg/day for males and 20, 83, and 420 mg/kg/day for females. Researchers noted reductions in body weight gain, liver damage, and reduced blood clotting function and platelet counts at 61 mg/kg/day in males and 420 mg/kg/day in females. Liver damage disappeared after exposure ended, but abnormalities in the blood were not entirely reversible. Researchers estimated the NOAEL at 14 mg/kg/day.[27] See the text box on **NOAEL, NOEL, LOAEL,** and **LOEL**.

NOAEL: No Observable Adverse Effect Level

NOEL: No Observed Effect Level

LOAEL: Lowest Observable Adverse Effect Level

LOEL: Lowest Observed Effect Level

- Imidacloprid dust was administered through the noses of rats for six hours a day, five days a week for four weeks at concentrations of 5.5, 30.0, and 190.0 mg/m^3. Male rats exhibited reduced body weight gain at the two highest doses and at the highest dose, increased liver enzyme activity and increased blood coagulation time was noted. Female rats exhibited increased liver enzyme activity at the two highest doses and at the highest dose, researchers noted enlarged livers and reduced thrombocyte counts. No effects were observed at the lowest dose.[28]

- Researchers applied a paste containing 1000 mg/kg imidacloprid to the shaved flanks and backs of rabbits, exposing the rabbits for 6 hours a day for 15 days. Rabbits showed no effects from the treatment.[29]

- Researchers fed imidacloprid to beagles for one year. Concentrations were 200, 500, or 1250 ppm for the first 16 weeks and 200, 500, and 2500 ppm for the remainder of the trial. Doses were equivalent to 6.1, 15.0, and 41.0 or 72.0 mg/kg/day. Researchers noted reduced food intake in the highest dose group. Females in this group exhibited increased plasma cholesterol concentrations at 13 and 26 weeks. Both males and females in this group exhibited increased cytochrome P450 activity in the liver and increases in liver weights at the end of the study. No adverse effects were observed at the two lowest doses.[30]

Humans

- No studies were found involving human subjects chronically exposed to imidacloprid. See the text box on **Exposure**.

Exposure: Effects of imidacloprid on human health and the environment depend on how much imidacloprid is present and the length and frequency of exposure. Effects also depend on the health of a person and/or certain environmental factors.

- The chronic dietary reference dose (RfD) has been set at 0.057 mg/kg/day based on chronic toxicity and carcinogenicity studies using rats. The NOAEL was estimated to be 5.7 mg/kg/day and the LOAEL was set at 16.9 mg/kg/day based on increased occurrence of mineralized particles in the thyroid gland of male rats.[31] See the text box on **Reference Dose (RfD)** (page 10).

Endocrine Disruption:

- No data were found evaluating the potential of imidacloprid to disrupt endocrine function.

- Imidacloprid is included in the draft list of initial chemicals for screening under the U.S. EPA Endocrine Disruptor Screening Program (EDSP).[32] The list of chemicals was generated based on exposure potential, not based on whether the pesticide is a known or likely potential endocrine disruptor.

Carcinogenicity:

Animals

- Researchers concluded that Scottish terriers treated with topical flea and tick products, including those containing imidacloprid, did not have a greater risk of developing urinary bladder cancer compared with control dogs.[33] Rats were fed imidacloprid for 18 or 24 months at unspecified concentrations. Although signs of toxicity were noted, researchers concluded that imidacloprid showed no evidence of carcinogenic potential.[20]
- A range of studies using both *in vitro* and *in vivo* techniques concluded that imidacloprid did not damage DNA.[19]

Humans

- The U.S. EPA has classified imidacloprid into Group E, no evidence of carcinogenicity, based on studies with rats and mice.[20,31] See the text box on **Cancer**.

> **Cancer: Government agencies in the United States and abroad have developed programs to evaluate the potential for a chemical to cause cancer. Testing guidelines and classification systems vary. To learn more about the meaning of various cancer classification descriptors listed in this fact sheet, please visit the appropriate reference, or call NPIC.**

- Imidacloprid has not been evaluated for the carcinogenicity by the International Agency for Research on Cancer (IARC), nor the National Toxicology Program (NTP).
- A study of human lymphocytes exposed to greater than 5200 µg/ml of imidacloprid demonstrated a slight increase in chromosome abnormalities *in vitro*, but this result was not found with *in vivo* tests.[19]

Reproductive or Teratogenic Effects:

Animals

- Rats were fed imidacloprid at doses of 10, 30, or 100 mg/kg/day on days 6 to 15 of their pregnancies.[20] On day 21 of the pregnancy, rats at the highest doses showed reduced embryo development and signs of maternal toxicity. In addition, wavy ribs were observed in the fetuses.[20,34]
- Researchers fed rabbits doses of imidacloprid at 8, 24, or 72 mg/kg/day during days 6-18 of pregnancy. On day 28 of pregnancy, researches noted maternal toxicity including death in the highest dose group, and the animals that survived in this group carried embryos with reduced rates of growth and bone ossification. In some of these rabbits, the young were aborted or resorbed.[20,35]
- In a two-generation study of reproductive toxicity, researchers dosed rats with 100, 250, or 700 ppm of imidacloprid in their diet for 87 days until rats mated. This was equivalent to 6.6, 17.0, and 47.0 mg/kg/day. Mother rats exhibited increased O-demethylase activity at doses of 17 mg/kg/day and greater. Reduced body weight gains were noted in pups at doses of 47 mg/kg/day. No effects on reproductive behavior or success were observed.[20,36]

Humans

- No human data were found on the reproductive effects of imidacloprid.

Fate in the Body:

Absorption

- The gastrointestinal tract of rats absorbed 92% of an unspecified dose. Plasma concentrations peaked 2.5 hours after administration.[19]
- Little systemic absorption through the skin occurs following dermal exposure in pets.[1]

- Researchers tested imidacloprid absorption using human intestinal cells. Cells rapidly absorbed imidacloprid at a very high rate of efficiency. Researchers concluded that an active transport system was involved.[37]

Distribution

- Researchers administered a single oral dose of radio-labeled imidacloprid at 20 mg/kg to male rats. One hour after dosing, imidacloprid was detected throughout the bodies with the exception of fatty tissues and the central nervous system.[38]
- No studies were found examining the distribution of imidacloprid in humans.

Metabolism

- Mammals metabolize imidacloprid in two major pathways discussed below. Metabolism occurs primarily in the liver.[20]
- In the first pathway, imidacloprid may be broken by oxidative cleavage to 6-chloronicotinic acid and imidazolidine. Imidazolidine is excreted in the urine, and 6-chloronicotinic acid undergoes further metabolism via glutathione conjugation to form mercaptonicotinic acid and a hippuric acid.[20,39]
- Imidacloprid may also be metabolized by hydroxylation of the imidazolidine ring in the second major pathway.[20,39] Metabolic products from the second pathway include 5-hydroxy and olefin derivatives.[40]

Excretion

- The metabolic products 5-hydroxy and olefin derivatives resulting from hydroxylation of the imidazolidine ring are excreted in both the feces and urine.[39,41]
- Metabolites found in urine include 6-chloronicotinic acid and its glycine conjugate, and accounted for roughly 20% of the original radio-labeled dose.[42]
- Metabolites in the feces accounted for roughly 80% of the administered dose in rats and included monohydroxylated derivatives in addition to unmetabolized imidacloprid, which made up roughly 15% of the total. Olefin, guanidine, and the glycine conjugate of methylthionicotinic acid were identified as minor metabolites.[2,42]
- Rats excreted 96% of radio-labeled imidacloprid within 48 hours following an unspecified oral dosing, with 90% excreted in the first 24 hours.[40] Radio-labeled imidacloprid was present in low amounts in organs and tissues 24 hours after male rats were orally dosed with 20 mg/kg.[38]
- No information was found on the specific metabolism of imidacloprid in humans.

Medical Tests and Monitoring:

- Researchers have tested for imidacloprid exposure in farm workers by evaluating urine samples with high performance liquid chromatography.[43] The method has not been well studied in humans and the clinical significance of detected residues is unknown.

Environmental Fate:

Soil

- Soil half-life for imidacloprid ranged from 40 days in unamended soil to up to 124 days for soil recently amended with organic fertilizers.[44] See the text box on **Half-life**.
- Researchers incubated three sandy loams and a silt loam in darkness following application of [^{14}C-*methylene*]-imidacloprid for a year. The

The "half-life" is the time required for half of the compound to break down in the environment.

1 half-life = 50% remaining
2 half-lives = 25% remaining
3 half-lives = 12% remaining
4 half-lives = 6% remaining
5 half-lives = 3% remaining

Half-lives can vary widely based on environmental factors. The amount of chemical remaining after a half-life will always depend on the amount of the chemical originally applied. It should be noted that some chemicals may degrade into compounds of toxicological significance.

degradation time required for imidacloprid to break down to half its initial concentration (DT_{50}) in non-agricultural soil was estimated to be 188-997 days. In cropped soils, the DT_{50} was estimated to be 69 days.[42] Metabolites found in the soil samples included 6-chloronicotinic acid, two cyclic ureas, olefinic cyclic nitroguanidine, a cyclic guanidine, and its nitroso and nitro derivatives. After 100 days, metabolites each accounted for less than 2% of the radiocarbon label.[42]

- Sorption of imidacloprid to soil generally increases with soil organic matter content.[45,46] However, researchers have demonstrated that sorption tendency also depends on imidacloprid concentration in the soil. Sorption is decreased at high soil concentrations of imidacloprid. As imidacloprid moves away from the area of high concentration, sorption again increases, limiting further movement.[46]
- Imidacloprid's binding to soil also decreases in the presence of dissolved organic carbon in calcareous soil. The mechanism may be through either competition between the dissolved organic carbon and the imidacloprid for sorption sites in the soil or from interactions between imidacloprid and the organic carbon in solution. Such interactions suggest that the potential for imidacloprid to leach into ground water would increase in the presence of dissolved organic carbon.[47]
- Researchers found no imidacloprid residue in soil 10-20 cm under or around sugar beets grown from treated seeds, and concluded that no leaching had occurred.[48]
- Metabolites found in agricultural soils used for growing sugar beets from imidacloprid-treated seed included 6-hydroxynicotinic acid, (1-[(6-chloro-3-pyridinyl)methul]-2-imidazolidone), 6-chloronicotinic acid, with lesser amounts of a fourth compound, 2-imidazolidone.[48]
- In another laboratory study of soil and imidacloprid, researchers determined that half lives varied by both product formulation and soil type. Metabolites were first detected 15 days after imidacloprid was applied.[49]
- Imidacloprid residues became increasingly bound to soil with time, and by the end of the one year test period, up to 40% of the radio-label could not be extracted from the soil samples.[42]
- In a water-sediment system, imidacloprid was degraded by microbes to a guanidine compound. The time to disappearance of one-half of the residues (DT_{50}) was 30-162 days.[42]
- Photodegradation at the surface of a sandy loam soil was rapid at first in a laboratory test, with a measured DT_{50} of 4.7 days, but the rate slowed after that time. Metabolites included 5-hydroxy-imidacloprid, which was the major product, and lesser amounts of an olefin, nitroso derivative, a cyclic urea, and 6-chloronicotinic acid in addition to two unidentified products.[42]

Water

- Imidacloprid is broken down in water by photolysis.[45] Imidacloprid is stable to hydrolysis in acidic or neutral conditions, but hydrolysis increases with increasing alkaline pH and temperature.[50]
- Researchers determined that hydrolysis of imidacloprid produced the metabolite 1-[(6-chloro-3-pridinyl)methyl]-2-imidazolidone.[50] This may be further broken down via oxidative cleavage of the N-C bond between the pyridine and imidazolidine rings, and the resulting compounds may be broken down into $C0_2$, $N0_3^-$, and Cl^-.[45]
- When imidacloprid was added to water at pH 7 and irradiated with a xenon lamp, half of the imidacloprid was photolyzed within 57 minutes.[42] Nine metabolites were identified in the water, of which five were most prominent. These included a cyclic guanidine derivative, a cyclic urea, an olefinic cyclic guanidine, and two fused ring products. These metabolites accounted for 48% of the radio carbon label following two hours of radiation, and the parent compound accounted for 23% of the label.[42]
- Although hydrolysis and photodegradation proceeded along different metabolic pathways in aqueous solution, the main metabolite was imidacloprid-urea in both cases.[45]

- At pH 7, only 1.5% of the initial concentration of 20 mg/L of imidacloprid was lost due to hydrolysis in three months, whereas at pH 9, 20% had been hydrolyzed in samples that were kept in darkness for the same time period.[50]
- The presence of dissolved organic carbon in calcareous soil may decrease the sorption potential of imidacloprid to soil, and thus increase the potential for imidacloprid to leach and contaminate groundwater.[47]
- A total of 28.7% of imidacloprid applied to a 25 cm soil column in the laboratory was recovered in leachate. Formulated products showed greater rates of leaching likely due to the effects of carriers and surfactants. Under natural conditions, soil compaction and rainfall amount may also affect leaching potential.[51]
- Imidacloprid is not expected to volatilize from water.[7]

Air

- Volatilization potential is low due to imidacloprid's low vapor pressure.[7]
- Imidacloprid is metabolized by photodegradation from soil surfaces and water.[42]

Plants

- Imidacloprid applied to soil is taken up by plant roots and translocated throughout the plant tissues.[2] Freshly cut sugar beet leaves contained 1 mg/kg imidacloprid residues up to 80 days following sowing of treated seed although residues were undetectable at harvest 113 days after sowing.[44] In a similar study, sugar beet leaves harvested 21 days after the sowing of treated seeds contained an average of 15.2 µg/g imidacloprid.[52]
- Researchers grew tomato plants in soil treated with 0.333 mg active ingredient per test pot, and monitored the plants and fruits for 75 days. Plants absorbed a total of 7.9% of the imidacloprid over the course of the experiment, although absorption of imidacloprid declined with time since application.[53]
- More than 85% of the imidacloprid taken up by the tomato plants was translocated to the shoots, and only small quantities were found in the roots. Shoot concentrations declined towards the top of the plant. These patterns were also seen in sugar beets grown from treated seed.[52] The tomato fruits also contained imidacloprid, although tissue concentrations were not related to the position of the fruits on the plant.[53]
- Although tomato fruits contained primarily unmetabolized imidacloprid, the plants' leaves also included small quantities of the guanidine metabolite, a tentatively identified olefin metabolite, and an unidentified polar metabolite in addition to the parent compound.[53] However, sugar beets grown from treated seed appeared to rapidly metabolize imidacloprid in the leaves. On day 97 after sowing, the majority of the radio-label was associated with metabolites, not the parent compound.[52]
- Researchers sprayed imidacloprid on eggplant, cabbage, and mustard crops at rates of 20 and 40 g/ha when the crops were at 50% fruit formation, curd formation, and pod formation, respectively.[54] The researchers calculated foliar half-lives of 3 to 5 days based on the measured residues.[54]
- Metabolites detected in the eggplant, cabbage, and mustard plants included the urea derivative [1-(6-chloropyridin-3-ylmethil)imidazolidin-2-one] and 6-chloronicotinic acid 10 days after foliar application. Residues of 2.15-3.34 µg/g were detected in the eggplant fruit.[54]
- Three plant metabolites of imidacloprid, the imidazolidine derivative, the olefin metabolite and the nitroso-derivative, were more toxic to aphids than imidacloprid itself.[55]

Indoor

- No information regarding indoor half-life or residues was found for imidacloprid.

- Researchers measured residue transfer of a commercial spot-on product containing imidacloprid on dogs' fur to people. Gloves worn to pat the dogs contained an average of 254 ppm of imidacloprid 24 hours following application of the product. Residues from the fur declined to an average of 4.96 ppm by the end of the first week.[56]

Food Residue

- The United States Department of Agriculture (USDA) Pesticide Data Program monitored imidacloprid residues in food and published their findings in 2006. Imidacloprid was detected in a range of fresh and processed fruits and vegetables. It was detected in over 80% of all bananas tested, 76% of cauliflower, and 72% of spinach samples. In all cases, however, the levels detected were below the U.S. EPA's tolerance levels. Imidacloprid was also found in 17.5 % of applesauce and 0.9% raisin samples, although percentage of detections were greater in the fresh unprocessed fruit (26.6% of apples sampled, and 18.1% of grapes sampled).[57]

- Imidacloprid was not one of the compounds sampled for the 2006 Food and Drug Administration (FDA) Center for Food Safety and Applied Nutrition's Pesticide Residue Monitoring Program.[57]

Ecotoxicity Studies:

Birds

- The acute LD_{50} for birds varies by species; it was determined to be 31 mg/kg in Japanese quail but 152 mg/kg in bobwhite quail. However, dietary LC_{50} values for a five-day interval were 2225 mg/kg/day for bobwhite quail and in excess of 5000 mg/kg for mallard ducks.[2]

Fish and Aquatic Life

- LC_{50} values for a 96-hour exposure were 237 mg/L for golden orfe (*Leuciscus idus*) and 21 mg/L for rainbow trout (*Oncorhyncus mykiss*).[2]

- Researchers determined LC_{50} values of 85 mg/L for *Daphnia* with a 48-hour exposure. A concentration of greater than 100 mg/L for 72 hours was required to reduce the growth rate of the alga *Pseudokirchneriella subcapitata* by 50%.[2]

- The EC_{50} of imidacloprid for *Daphnia magna* was 96.65 mg/L. However, the EC_{50} declined to 90.68 mg/L when predator cues were added to the water as an additional stress. Sublethal exposures reduced feeding and increased respiration rates in *Daphnia*. Exposed *Daphnia* did not respond to predator cues as quickly as did control animals, and failed to mature as quickly or produce as many young. These changes led to reduced population growth rate following exposure.[58] See the text box on **EC_{50}**.

EC_{50}: The median effective concentration (EC_{50}) may be reported for sublethal or ambiguously lethal effects. This measure is used in tests involving species such as aquatic invertebrates where death may be difficult to determine. This term is also used if sublethal events are being monitored.

Newman, M.C.; Unger, M.A. *Fundamentals of Ecotoxicology*; CRC Press, LLC.: Boca Raton, FL, 2003; p 178.

Terrestrial Invertebrates

- Oral LD_{50} values for bees range from 3.7 to 40.9 ng per bee, and contact toxicity values ranged from 59.7 to 242.6 ng per bee.[59] Based on these values, imidacloprid is considered to be highly toxic to bees.[18] Colonies of bees (*Apis mellifera*) appeared to vary in their sensitivity to imidacloprid, perhaps due to differences in oxidative metabolism among colonies. The 5-hydroxyimidacloprid and olefin metabolites were more toxic to honeybees than the parent compound.[60]

- Bees were offered sugar solution spiked with imidacloprid at nominal concentrations of 1.5, 3.0, 6.0, 12.0, 24.0, 48.0, or 96.0 µg/kg for 14 days. The experiment was repeated with bees that matured in July (summer bees) and between December and February (winter bees). Summer bees died at greater rates than controls in the 96 µg/kg treatment, whereas winter bees demonstrated increased mortality at 48 µg/kg. Reflex responses of summer bees decreased at 48 µg/kg, whereas the reflex responses of winter bees were unaffected. Learning responses in summer bees were decreased following exposures of 12 µg/kg imidacloprid, and winter bees demonstrated reduced learning responses at doses of 48 µg/kg.[61]

- Surveys of pollen collected by bees from five locations in France revealed detectable residues of imidacloprid or its metabolite 6-chloronicotinic acid in 69% of the samples. Maximum detected concentrations were 5.7 µg/kg and 9.3 µg/kg for imidacloprid and the metabolite, respectively.[62]
- Researchers performed 10-day chronic exposure tests on honeybees and found that mortality increased over controls at doses as low as 0.1 µg/L of imidacloprid and six metabolites.[60]
- Researchers fed bumblebees (*Bombus terrestris*) nectar and pollen spiked with either 10 µg/kg or 25 µg/kg imidacloprid in syrup and 6 µg/kg or 16 µg/kg in pollen. Worker survival rates declined by 10% in both treatment groups and brood production was reduced in the low-dose group.[63]
- Researchers grew sunflowers from seeds treated with 0.7 mg imidacloprid per seed and found imidacloprid residue in nectar (1.9 ±1 ppt) and pollen (3.3 ± 1 ppt). No metabolites were found in nectar or pollen. They also grew sunflowers from untreated seeds in soil with imidacloprid residues at concentrations up to 15.7 ppt. In that test, neither imidacloprid nor its metabolites were found in nectar or pollen.[59]
- Researchers have found that bees avoided feeding on a sugar solution spiked with imidacloprid at 24 µg/kg concentrations, and that this avoidance appeared to be due to a repellent or antifeedant effect.[64]
- The predatory insect *Hippodamia undecimnotata* experienced reduced survival, delayed and reduced egg production, reduced longevity, and reduced population growth rate following exposure to aphids raised on potted bean plants which had been treated 10 days earlier with imidacloprid applied at 0.0206 mg active ingredient per pot or 1/14 the label rate.[65]
- Adult green lacewings (*Chrysoperla carnea*) exhibited reduced survival rates after feeding on the nectar of greenhouse plants that had been treated with granules of a commercial product containing 1% imidacloprid. Treatments were done with imidacloprid-containing products mixed at label rates and at twice the label rate three weeks prior to the experiment. Insects fed on the treated plants even when untreated plants were present.[66]
- The LC_{50} for the earthworm *Eisenia foetida* was determined to be 10.7 mg/kg in dry soil.[2] In a separate study, two earthworm species (*Aporrectodea nocturna* and *Allolobophoria icterica*) were placed in soil cores treated with 0.1 or 0.5 mg/kg imidacloprid. At the highest dose, both species of worms produced shorter burrows. *A. nocturna* also produced fewer surface casts at the highest dose, and gas diffusion through the soil cores was reduced by approximately 40% compared to controls.[67]

Regulatory Guidelines:

- The reference dose (RfD) is 0.057 mg/kg/day.[31] See the text box on **Reference Dose (RfD)**.
- The U.S. EPA has classified imidacloprid into Group E, no evidence of carcinogenicity, based on studies with rats and mice.[20,31] See the text box on **Cancer** (page 5).
- The acute Population Adjusted Dose (aPAD) is 0.14 mg/kg.[31]
- The chronic Population Adjusted Dose (cPAD) is 0.019 mg/kg/day.[31]

Reference Dose (RfD): The RfD is an estimate of the quantity of chemical that a person could be exposed to every day for the rest of their life with no appreciable risk of adverse health effects. The reference dose is typically measured in milligrams (mg) of chemical per kilogram (kg) of body weight per day.

U.S. Environmental Protection Agency, Technology Transfer Network, Air Toxics Health Effects Glossary, 2009. http://www.epa.gov/ttnatw01/hlthef/hapglossaryrev.html#RfD

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NPIC is a cooperative agreement between Oregon State University and the U.S. Environmental Protection Agency (U.S. EPA, cooperative agreement # X8-83458501). The information in this publication does not in any way replace or supersede the restrictions, precautions, directions, or other information on the pesticide label or any other regulatory requirements, nor does it necessarily reflect the position of the U.S. EPA.

FIPRONIL
TECHNICAL FACT SHEET

npic
NATIONAL PESTICIDE INFORMATION CENTER
1.800.858.7378

NPIC Technical Fact Sheets provide information that is complex and intended for individuals with a scientific background and/or familiarity with toxicology and risk assessment. This document is intended to promote informed decision-making. Please refer to the General Fact Sheet for less technical information.

Chemical Class and Type:

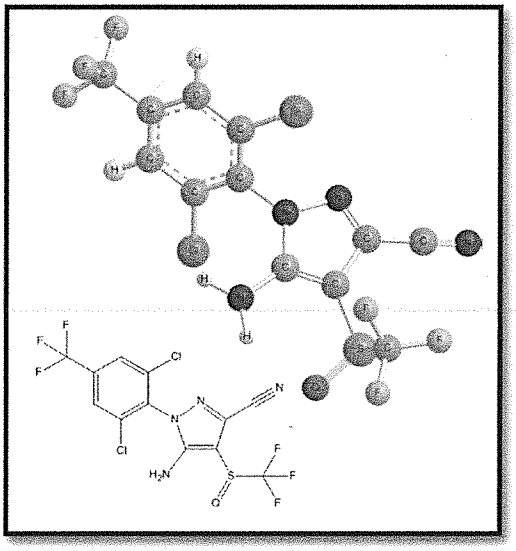
- Fipronil is a broad-spectrum phenylpyrazole insecticide. The International Union of Pure and Applied Chemistry (IUPAC) name for fipronil is (±)-5-amino-1-(2,6-dichloro-α,α,α-trifluoro-*p*-tolyl)-4-trifluoromethylsulfinylpyrazole-3-carbonitrile. The Chemical Abstracts Service (CAS) registry number is 120068-37-3.[1]
- Fipronil was first registered for use by the United States Environmental Protection Agency (U.S. EPA) in May 1996.[2] See the text box on **Laboratory Testing**.

Laboratory Testing: Before pesticides are registered by the U.S. EPA, they must undergo laboratory testing for short-term (acute) and long-term (chronic) health effects. Laboratory animals are purposely given high enough doses to cause toxic effects. These tests help scientists judge how these chemicals might affect humans, domestic animals, and wildlife in cases of overexposure.

Physical / Chemical Properties:

- Technical grade fipronil is a white powder with a moldy odor.[1,2]
- Vapor pressure[1,2]: 2.8 x 10^{-9} mmHg at 25 °C
- Octanol-Water Partition Coefficient (K_{ow})[1,2]: 1.00 x 10^{4}
- Henry's constant[1]: 3.7 x 10^{-5} atm·m^3/mol
- Molecular weight[1]: 437.2 g/mol
- Solubility (water)[1]: 0.0019 g/L (pH 5); 0.0024 g/L (pH 9) at 20 °C
- Soil Sorption Coefficient (K_{oc})[3]: The average K_{oc} value for fipronil when tested in eight soil types was 825 ± 214, and the K_{oc} values for fipronil-sulfide and fipronil-desulfinyl were 3946 ± 2165 and 2010 ± 1370, respectively.

Molecular Structure - Fipronil



Uses:

- Fipronil is used to control ants, beetles, cockroaches, fleas, ticks, termites, mole crickets, thrips, rootworms, weevils, and other insects.[1,2,4] Uses for individual fipronil products vary widely. Always read and follow the label when applying pesticide products.
- Fipronil is used in granular turf products, seed treatments, topical pet care products, gel baits, liquid termiticides, and in agriculture.[4]
- Signal words for products containing Fipronil may range from Caution to Warning. The signal word reflects the combined toxicity of the active ingredient and other ingredients in the product. See the pesticide label on the product and refer to the NPIC fact sheets on ***Signal Words*** and ***Inert or "Other" Ingredients***.
- To find a list of products containing fipronil which are registered in your state, visit the website http://npic.orst.edu/reg/state_agencies.html and search by "active ingredient."

Mode of Action:

Target and Non-target Organisms

- Fipronil is toxic to insects by contact or ingestion.[1]
- Fipronil blocks $GABA_A$-gated chloride channels in the central nervous system. Disruption of the $GABA_A$ receptors by fipronil prevents the uptake of chloride ions resulting in excess neuronal stimulation and death of the target insect.[5,6,7]
- Fipronil exhibits differential binding affinity for $GABA_A$ receptor subunits, with a higher binding affinity for insect receptor complexes compared to mammalian complexes. The lower binding affinity for mammalian receptors enhances selectivity for insects and increases the margin of safety for people and animals.[5,6,8,9]
- Fipronil-sulfone, the primary biological metabolite of fipronil, is reported to be twenty times more active at mammalian chloride channels than at insect chloride channels.[10] Fipronil-sulfone is reportedly six times more potent in blocking vertebrate GABA-gated chloride channels than fipronil, but demonstrates similar toxicity to the parent compound in mammals.[8]
- Fipronil-desulfinyl, the primary environmental metabolite (photoproduct) of fipronil, is 9-10 times more active at the mammalian chloride channel than the parent compound, reducing the selectivity between insects and humans when exposed to this metabolite.[8,11]

LD_{50}/LC_{50}: A common measure of acute toxicity is the lethal dose (LD_{50}) or lethal concentration (LC_{50}) that causes death (resulting from a single or limited exposure) in 50 percent of the treated animals. LD_{50} is generally expressed as the dose in milligrams (mg) of chemical per kilogram (kg) of body weight. LC_{50} is often expressed as mg of chemical per volume (e.g., liter (L)) of medium (i.e., air or water) the organism is exposed to. Chemicals are considered highly toxic when the LD_{50}/LC_{50} is small and practically non-toxic when the value is large. However, the LD_{50}/LC_{50} does not reflect any effects from long-term exposure (i.e., cancer, birth defects or reproductive toxicity) that may occur at levels below those that cause death.

Acute Toxicity:

Oral

- Technical grade fipronil is considered moderately toxic by ingestion with an oral LD_{50} of 97 mg/kg in rats and an LD_{50} of 95 mg/kg in mice.[1] See the text boxes on **Toxicity Classification** and **LD_{50}/LC_{50}**.
- Investigators fed rats a single dose of fipronil by gavage at a dose of 0, 2.5, 7.5, or 25.0 mg/kg. The lowest dose that produced adverse effects (LOAEL) was 7.5 mg/kg. At that dose, male rats displayed decreased hindlimb splay at 7 hours following administration. Researches also observed decreased body weight gain, decreased food consumption and food efficiency, and decreased grooming among female rats at 7 days after the single 7.5 mg/kg dose. All treatment-related effects resolved by 14 days following the single dose, except decreased grooming among female rats. The acute NOAEL for fipronil was 2.5 mg/kg.[12] See the text box on **NOAEL, NOEL, LOAEL**, and **LOEL** (page 4).
- The acute oral LD_{50} of fipronil-desulfinyl (primary photodegradate) in rats is 15 and 18 mg/kg for females and males, respectively.[13]

Dermal

- Fipronil is low to moderate in toxicity by contact with a dermal LD_{50} of >2,000 mg/kg in rats and 354 mg/kg in rabbits.[2]
- Researchers applied 15 doses of fipronil to the intact skin of rabbits at doses of 0.5, 1.0, 5.0, and 10.0 mg/kg/day for 6-hour periods over 21 days and observed "decreased mean body weight gain and food consumption" at the highest dose tested. The systemic NOAEL for fipronil was 5.0 mg/kg/day.[12]
- Fipronil may cause slight skin irritation. Fipronil was not found to be a skin sensitizer when tested on guinea pigs.[2]
- Fipronil may cause mild eye irritation that typically clears within 24 hours.[2]

TOXICITY CLASSIFICATION - FIPRONIL

	High Toxicity	Moderate Toxicity	Low Toxicity	Very Low Toxicity
Acute Oral LD_{50}	Up to and including 50 mg/kg (≤ 50 mg/kg)	**Greater than 50 through 500 mg/kg (> 50 – 500 mg/kg)**	Greater than 500 through 5000 mg/kg (> 500 – 5000 mg/kg)	Greater than 5000 mg/kg (> 5000 mg/kg)
Inhalation LC_{50}	Up to and including 0.05 mg/L (≤ 0.05 mg/L)	**Greater than 0.05 through 0.5 mg/L (>0.05 – 0.5 mg/L)**	**Greater than 0.5 through 2.0 mg/L (>0.5 – 2.0 mg/L)**	Greater than 2.0 mg/L (> 2.0 mg/L)
Dermal LD_{50}	Up to and including 200 mg/kg (≤ 200 mg/kg)	Greater than 200 through 2000 mg/kg (> 200 - 2000 mg/kg)	**Greater than 2000 through 5000 mg/kg (>2000 – 5000 mg/kg)**	Greater than 5000 mg/kg (> 5000 mg/kg)
Primary Eye Irritation	Corrosive (irreversible destruction of ocular tissue) or corneal involvement or irritation persisting for more than 21 days	Corneal involvement or other eye irritation clearing in 8 – 21 days	**Corneal involvement or other eye irritation clearing in 7 days or less**	Minimal effects clearing in less than 24 hours
Primary Skin Irritation	Corrosive (tissue destruction into the dermis and/or scarring)	Severe irritation at 72 hours (severe erythema or edema)	Moderate irritation at 72 hours (moderate erythema)	**Mild or slight irritation at 72 hours (no irritation or erythema)**

The highlighted boxes reflect the values in the "Acute Toxicity" section of this fact sheet. Modeled after the U.S. Environmental Protection Agency, Office of Pesticide Programs, Label Review Manual, Chapter 7: Precautionary Labeling

Inhalation

- Fipronil is low to moderate in toxicity by inhalation with the 4-hour LC_{50} ranging from 0.390 to 0.682 mg/L in rats.[1,2]

Signs of Toxicity - Animals

- Mice injected intraperitoneally with fipronil exhibited tonic-clonic seizures, facial clonus, or head twitching.[5,14]
- Signs of acute toxicity in rats and mice given single doses of fipronil via oral or inhalation exposure generally include changes in activity or gait, hunched appearance, tremors, convulsions, and seizures.[7]
- Clinical signs of toxicity in mice fed doses of fipronil (87.4-97.2%) in the diet for 6 weeks included overactivity, irritability, abnormal gait or posture, body tremors, convulsions, and death.[7]
- Signs of toxicity during a 52-week chronic rat feeding study included reduced feeding and food conversion efficiency, reduced body weight gain, seizures and seizure-related death, changes in thyroid hormones, increased mass of the liver and thyroid, and kidney effects.[12]

Signs of Toxicity - Humans

- Clinical signs and symptoms reported after ingestion of fipronil by humans include sweating, nausea, vomiting, headache, abdominal pain, dizziness, agitation, weakness, and tonic-clonic seizures. Clinical signs of exposure to fipronil are generally reversible and resolve spontaneously.[15,16,17]
- In one case report, a 50-year-old man complained of headache, nausea, vertigo, and weakness after spraying his field with a fipronil product for five hours. Symptoms were reported to have developed after two hours and resolved spontaneously. The authors suggested inhalation or dermal contact as the routes of exposure, although there were no signs of conjunctivitis or skin irritation.[18]
- Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to discuss an incident with the National Pesticide Information Center, please call 1-800-858-7378.

Chronic Toxicity:

Animals

- Investigators fed rats 0.5 ppm (0.019-0.025 mg/kg/day) fipronil in their diets for 52 weeks and observed no signs of systemic toxicity (NOAEL). The lowest dosage at which effects were observed (LOAEL) was 1.5 ppm (0.059 mg/kg/day males, 0.078 mg/kg/day females), and included increased incidence of seizures and death, protein alterations, and alterations in thyroid hormone levels.[12] See the text box on **NOAEL, NOEL, LOAEL,** and **LOEL.**

NOAEL: No Observable Adverse Effect Level
NOEL: No Observed Effect Level
LOAEL: Lowest Observable Adverse Effect Level
LOEL: Lowest Observed Effect Level

- Researchers fed dogs 0.2 mg/kg/day fipronil (length unknown) and observed no adverse effects. In the same study, researchers observed clinical signs of neurotoxicity at 2.0 mg/kg/day.[2]
- Scientists fed rats fipronil-desulfinyl (primary photodegradate) at 0, 0.5, 2.0, or 10.0 ppm for two years (0, 0.025, 0.098, and 0.050 mg/kg/day males, and 0, 0.032, 0.130, and 0.550 mg/kg/day females). The 10 ppm dose was reduced to 6 ppm for female rats after week 26 due to increased mortality. Male and female rats displayed increased incidence of aggression and irritability to touch at the highest doses tested. Female rats also developed bloody tears and increased salivation at 10 or 6 ppm, and convulsions at 2 and 10 or 6 ppm. No effects were seen at or below 0.5 ppm (0.025 mg/kg/day).[19]

Humans

- The chronic reference dose (RfD) for fipronil is 0.0002 mg/kg/day based on the NOAEL for chronic toxicity (0.5 ppm or 0.019 mg/kg/day) and an uncertainty factor of 100.[12] See the text boxes on **Reference Dose (RfD)** (page 9).

Exposure: Effects of fipronil on human health and the environment depend on how much fipronil is present and the length and frequency of exposure. Effects also depend on the health of a person and/or certain environmental aspects.

- No human data were found on chronic effects of fipronil. See the text box on **Exposure.**

Endocrine Disruption:

- Data from short-term and long-term toxicity studies with fipronil in rats, rabbits, mice and dogs "do not suggest any endocrine disruption activity".[20] In long term studies fipronil was shown to decrease thyroid hormone levels in rats. However, researchers concluded this effect resulted from "increased clearance, rather than a direct effect on the thyroid."[20]
- In a 2-year dietary study with rats, investigators observed thyroid tumors in rats related to altered thyroid-pituitary status at the highest dose tested (300 ppm). Results were determined to be specific to rats.[20]

Carcinogenicity:

Animals

- Researchers administered fipronil to rats at doses of 0, 0.5, 1.5, 30.0, and 300.0 ppm in the diet for nearly two years and observed increased incidence of benign and malignant follicular cell tumors in the thyroid gland for both sexes at the highest dose tested.[12]
- Investigators fed fipronil-desulfinyl (primary photoproduct) to rats at 0, 0.5, 2.0, and 10.0 ppm for 2 years (0, 0.025, 0.098, and 0.050 mg/kg/day males, and 0, 0.032, 0.13, and 0.55 mg/kg/day females) for 2 years. The 10 ppm dose was reduced to 6 ppm for female rats after week 26 due to increased mortality. Male rats at 10 ppm and female rats at 2, 6, and 10 ppm developed clinical signs of toxicity with no evidence of carcinogenicity.[19]
- Researchers often use studies designed to test for mutagenicity to screen chemicals for carcinogenicity. Fipronil did not cause mutations in human lymphocytes, Chinese hamster V79 cells, *Salmonella* (Ames test), or mouse micronuclei.[2]

Cancer: Government agencies in the United States and abroad have developed programs to evaluate the potential for a chemical to cause cancer. Testing guidelines and classification systems vary. To learn more about the meaning of various cancer classification descriptors listed in this fact sheet, please visit the appropriate reference, or call NPIC.

Humans

- The U.S. EPA classified fipronil as "Group C - possible human carcinogen," based on "increases in thyroid follicular cell tumors in both sexes of the rat."[12] See the text box on **Cancer**.
- No human data were found on carcinogenic effects of fipronil.

Reproductive or Teratogenic Effects:

Animals

- Researchers administered fipronil to rats (route of exposure not included) to determine reproductive effects. No reproductive effects were noted at 30 ppm (2.54 mg/kg/day in males and 2.74 mg/kg/day in females), though systemic toxicity, including increased thyroid and liver weights (males and females), decreased pituitary gland weights (females), and an increased incidence of thyroid hypertrophy (females) were observed. The lowest dosage at which reproductive effects were observed was 300 ppm (26.0 mg/kg/day in males and 28.4 mg/kg/day in females) based on unspecified clinical signs in the offspring, reduced litter size, decreased body weights, decreased mating, reduced fertility, reduced post-implantation and offspring survival, and delay in physical development.[2]
- In a dietary short-term developmental neurotoxicity study, the LOAEL was 0.90 mg/kg/day based on a significant decrease in pup weights during lactation, and signs of delayed of sexual development in males.[12]

Humans

- No human data were found on the teratogenic or reproductive effects of fipronil.

Fate in the Body:

Absorption

- Researchers applied a 79% solution of ^{14}C-fipronil to the backs of shaved rats. Test samples showed radio-labeled fipronil in blood, carcass, cage wash and wipe, urine, and feces. Researchers found less than 1% of the applied dose was absorbed after 24 hours at all doses tested.[7]
- In an *in vitro* study of ^{14}C-fipronil absorption through human, rabbit, and rat epidermal membranes, researchers recorded penetration rates after eight hours of 0.08% (rat), 0.07% (rabbit), and 0.01% (human) of the applied dose of 200 g/L fipronil solution. Researchers reported greater absorption from a 0.2 g/L solution of fipronil, with 0.9% (rat), 13.9% (rabbit), 0.9% (humans) of the dose being absorbed.[7]
- In another *in vitro* study, researchers measured penetration of fipronil through human epidermal membranes (0.15-3.00%) and rat epidermal membranes (1-35%), after 24 hours. Variation in absorption was dependent on the dilution rate of fipronil, as more diluted mixtures had a lower penetration rate and higher overall mean penetration.[21]
- A spot-on treatment study with ^{14}C-fipronil on dogs and cats found that radio-labeled fipronil was distributed primarily in the superficial skin layers. Radio-labeled fipronil was not detected in the dermis or the hypodermis (adipose tissue).[22]
- Scientists applied doses of 0.08 to 7.20 mg of ^{14}C fipronil-desulfinyl (primary photoproduct) to the skin of rats. Approximately 0.2-7.0% of the applied dose penetrated the skin over a 24-hour period.[7]
- Researchers administered radio-labeled fipronil to goats in feed at doses of 0.05, 2.00, and 10.00 ppm for seven days and found that absorption ranged from 15-33%. A study in rats found absorption rates between 30-50% after oral administration of fipronil.[19]

Distribution

- Fipronil is widely distributed in mammals and is found predominantly in fatty tissues. Rats given a single oral dose had the highest concentrations of fipronil in the stomach, Gastrointestinal (GI) tract, fat, and adrenals. Moderate levels were found in the liver, pancreas, thyroid, and ovaries. Low levels were present in the muscle, brain, heart, and cardiac blood.[2,7]
- A spot-on treatment study in dogs and cats detected ^{14}C-fipronil concentrated in the sebaceous glands, epithelial layers surrounding the hairs, and exposed part of the hair shaft 2 months after treatment, suggesting the passive diffusion of fipronil in the sebum covering hair and skin.[22]
- Researchers applied a spot-on fipronil product to dogs and vigorously petted them for 5 minutes every day with cotton gloves to mimic normal exposures to treated animals. Residues transferred to the gloves peaked at 589 (± 206) ppm fipronil 24 hours after treatment, decreased steadily over time (448 ± 118 ppm after 8 days), and were undetectable after 36 days.[16]

Metabolism

- The whole-blood half-life of fipronil in rats ranged from about 6.2-8.3 days after a single 4 mg/kg oral dose and decreased significantly to 2.1-2.3 days after a single 150 mg/kg oral dose.[2]
- The primary metabolite of fipronil in armyworms, mice, and presumably other insects and vertebrates is the fipronil-sulfone derivative.[8,11] Researchers injected mice with fipronil and detected the sulfone derivative in the brain, liver, kidney, fat, and feces.[11]
- Fipronil-desulfinyl, the primary photodegradate of fipronil, has been measured in the fat, brain, liver, kidney, skin, and feces of mice, rats and lactating goats after oral exposure or injection.[7,11,19]

Excretion

- Rats given an oral dose of fipronil excreted 45-75% in the feces and 5-25% in the urine. The parent compound and the oxidation product, fipronil-sulfone, were present in both media.[2,7]
- Lactating goats ingested fipronil for seven days and excreted 18-64% of the compound in the feces and 1-5% in milk; 8-25% remained in body tissues.[7]
- Goats dosed with fipronil-desulfinyl excreted 20-50% in feces and 3-7% in the urine.[19]

Medical Tests and Monitoring:

- Exposure to fipronil and its metabolites can be measured via a blood sample or in the gastric lavage fluid. Samples should be collected as soon after the exposure as possible.[21] Methods of analysis include an ELISA developed to detect total fipronil (fipronil and its metabolites) and liquid chromatography mass spectrometry which can distinguish fipronil from its sulfone and desulfinyl metabolites.[17]
- Fipronil was not among the pesticides included for biomonitoring assessment in the third National Health and Nutrition Examination Survey (NHANES).[23]

The "half-life" is the time required for half of the compound to break down in the environment.

1 half-life = 50% remaining
2 half-lives = 25% remaining
3 half-lives = 12% remaining
4 half-lives = 6% remaining
5 half-lives = 3% remaining

Half-lives can vary widely based on environmental factors. The amount of chemical remaining after a half-life will always depend on the amount of the chemical originally applied. It should be noted that some chemicals may degrade into compounds of toxicological significance.

Environmental Fate:

Soil

- The half-life of fipronil is 122-128 days in aerobic soils. Under aerobic conditions, naturally occurring soil organisms break down fipronil to form fipronil-sulfone. Fipronil can also be hydrolyzed to form fipronil-amide.[2] See the text box on **Half-life.**

- Fipronil degrades on soil surfaces by ultraviolet radiation (i.e., sunlight) to form fipronil-desulfinyl, and has a measured half-life of 34 days in loamy soil. However, soil particles may prevent light from penetrating any significant depth of soil under field conditions and thereby increase residence time.[2,24]
- In studies to determine the fate of fipronil in soil, researchers found "no evidence of volatility" of fipronil or fipronil metabolites.[2]
- Fipronil has low mobility in soil and is not expected to leach into groundwater. After soil treatment, fipronil usually does not travel further than the upper six inches of soil, and significant lateral movement is not expected.[1,2,25]
- The K_{oc} values for fipronil range from 427-1248 in sandy loam, but will vary depending on clay and organic carbon content of the soil. The K_{oc} is 3946 (± 2165) for fipronil-sulfide and 2010 (± 1370) for fipronil-desulfinyl.[1,25]

Water

- Fipronil degrades rapidly in water when exposed to UV light to form fipronil-desulfinyl. Under these conditions, fipronil has a half-life of 4 to 12 hours.[24,26]
- Fipronil is stable to hydrolysis at pH 5 and pH 7. However, it degrades in alkaline conditions in direct proportion to increasing pH values. Fipronil-amide is the primary residue formed from hydrolysis.[2,24,26]
- Fipronil was measured in surface water at concentrations of 0.829 to 5.290 µg/L in southwestern Louisiana during March through April, which corresponds to the timing of releases of ricefield tailwater. Results indicate that fipronil degradation products accumulate in riverbed sediment while the parent compound does not.[27]
- Fipronil-desulfinyl photodegrades in aerated and static water with recorded half-lives of 120 (± 18) hours and 149 (± 39) hours, respectively.[26]
- Fipronil and fipronil-desulfinyl are less volatile than water and can concentrate under field conditions.[1,2]

Air

- The vapor pressure for fipronil is 3.7×10^{-4} mPa at 25 °C.[1] Photodegradation studies in soil found no evidence of volatility of fipronil or its metabolites.[2]

Plants

- Fipronil is not well absorbed by plants after soil treatment (about 5%) and partially degrades in plants to the sulfone and amide derivatives. Fipronil applied to foliage partially photodegrades to form fipronil-desulfinyl.[1]

Indoor

- No indoor fate data were found.

Food Residue

- The United States Food and Drug Administration (FDA) Pesticide Residue Monitoring Program conducts regulatory and incidence/level monitoring for pesticide residues in domestic and imported foods (except meat, poultry, dairy, and eggs). In 2003, the FDA analyzed 84 domestic samples (3.6% of domestic samples) for levels of fipronil for tolerance compliance. No samples contained detectable levels of fipronil.[28]
- In 2003, the FDA analyzed more than 150 imported food samples for levels of fipronil. Two samples had residues of fipronil that exceeded the legal limit (tolerance).[28]
- The United States Department of Agriculture (USDA) conducts regulatory monitoring for pesticide residues in meat, poultry, dairy, and eggs. In 2006, the USDA analyzed 655 poultry breast samples and 655 poultry thigh samples for levels of fipronil. One poultry breast (0.2%) and 2 poultry thighs (0.3%) had detectible levels of fipronil. No samples contained residues that exceeded the established U.S. EPA tolerances.[29]

- From 2003-2006 the USDA analyzed other commodities for fipronil residues, including butter (732 samples in 2003), milk (739 samples in 2004 and 746 samples in 2005), heavy cream (369 samples in 2005), and pork (352 samples in 2005), and found that no samples contained residues that exceeded U.S. EPA tolerances.[30]

Ecotoxicity Studies:

Birds

- Fipronil is highly toxic to bobwhite quail and pheasants, with an acute oral LD_{50} of 11.3 mg/kg and 31.0 mg/kg, respectively. Fipronil also has high sub-acute toxicity with a 5-day dietary LC_{50} of 49 mg/kg in bobwhite quail.[1]
- Fipronil is practically non-toxic to mallard ducks with no documented acute, sub-acute, or chronic effects.[1,2]
- The fipronil-sulfone metabolite is highly toxic to upland game birds and moderately toxic to waterfowl by ingestion.[2]

Fish and Aquatic Life

- Fipronil is highly to very highly toxic to marine and freshwater fish. The 96-hour LC_{50} is 0.246 mg/L for rainbow trout, 0.083 mg/L for bluegill sunfish, and 0.130 mg/L for sheepshead minnows.[2]
- Fipronil-sulfone is 6.3 and 3.3 times more toxic to rainbow trout and bluegill sunfish, respectively, than the parent compound.[2]
- Fipronil accumulates in fish with a bioconcentration factor of 321 for whole fish, 164 for edible tissue, and 575 for non-edible tissue. Fish eliminated fipronil completely 14 days after being transferred to clean water. The primary metabolites in fish are fipronil-sulfone and fipronil-sulfide.[2]
- Fipronil is highly toxic to freshwater invertebrates. In daphnids, the NOEL for fipronil was measured at 9.8 µg/L, and the LOEL was 20.0 µg/L. The fipronil-sulfone and fipronil-desulfinyl metabolites are 6.6 and 1.9 times more toxic to freshwater invertebrates, respectively, than the parent compound.[2]
- In one study, male copepods reared in a 0.63 µg/L fipronil solution had a 75-89% decrease in reproductive success. Carry-over effects were significant for males (but not females) moved to clean seawater three days before mating.[31]
- Fipronil is highly toxic to oysters with an EC_{50} of 0.77 mg/L and very highly toxic to mysid shrimp with a 96-hour LC_{50} of 140 ng/L. Exposure to less than 5.0 ng/L fipronil affected mysid growth, reproduction, and survival.[2] See the text box on **EC_{50}**.
- When applied to water, fipronil varies greatly in its toxicity and potential to bioaccumulate in aquatic arthropods, depending on the species.[32]

EC_{50}: The median effective concentration (EC_{50}) may be reported for sublethal or ambiguously lethal effects. This measure is used in tests involving species such as aquatic invertebrates where death may be difficult to determine. This term is also used if sublethal events are being monitored.

Newman, M.C.; Unger, M.A. *Fundamentals of Ecotoxicology*; CRC Press, LLC.: Boca Raton, FL, 2003; p 178.

Terrestrial Invertebrates

- Fipronil is highly toxic to honeybees by contact and ingestion when applied to plant foliage.[1]
- Researchers found that fipronil killed 38.8-94.5% of beneficial predators such as *Orius spp.* (flower bug) and *Geocoris spp.* (big-eyed bug) and significantly reduced reproductive success and prey consumption when applied at labeled rates.[33]
- When applied to fields for locust control, fipronil killed >90% of the resident nontarget insects *Carabidae, Tenebrionidae, Scelionidae,* and *Sphecidae* populations in 2 days. Recolonization was very poor for 2-4 weeks, depending on the application rate.[34]
- Fipronil treated soil is non-toxic to worms, including earthworms of the *Pheretima* group.[1,35]

Regulatory Guidelines:

- The RfD for fipronil is 2.0×10^{-4} mg/kg/day based on the NOAEL for chronic toxicity (0.500 ppm or 0.019 mg/kg/day).[12] See the text box on **Reference Dose (RfD)**.
- The U.S. EPA has classified fipronil as "Group C - possible human carcinogen" based on "increases in thyroid follicular cell tumors in both sexes of the rat."[12] See the text box on **Cancer** (page 5).

Reference Dose (RfD): The RfD is an estimate of the quantity of chemical that a person could be exposed to every day for the rest of their life with no appreciable risk of adverse health effects. The reference dose is typically measured in milligrams (mg) of chemical per kilogram (kg) of body weight per day.

U.S. Environmental Protection Agency, Technology Transfer Network, Air Toxics Health Effects Glossary, 2009. http://www.epa.gov/ttnatw01/hlthef/hapglossaryrev.html#RfD

- There are no recommended or regulatory occupational exposure limits for fipronil.

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NPIC is a cooperative agreement between Oregon State University and the U.S. Environmental Protection Agency (U.S. EPA, cooperative agreement # X8-83458501). The information in this publication does not in any way replace or supersede the restrictions, precautions, directions, or other information on the pesticide label or any other regulatory requirements, nor does it necessarily reflect the position of the U.S. EPA.

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VIRGINIA POLLUTION ABATEMENT PERMIT APPLICATION
FORM A
ALL APPLICANTS

1. Facility	Name	Kuzzens- Mappsville North Packing Plant
	County/City	Accomack County
	Address	12201 Lankford Highway Mappsville, Virginia 23301
2. Owner	Legal Name	Kuzzens, Inc.
	Mailing Address	3769 Grapeland Circle Exmore, Virginia 23550
	Telephone Number	757-442-4961
	Email address	
3. Owner Contact	Name	Richard Davis
	Title	Farm Manager
	Mailing Address	3769 Grapeland Circle Exmore, Virginia 23550
	Telephone Number	757-442-4961
	Email address	richard.davis@lipmanproduce.com

4. Existing permits (e.g., VPA, VPDES; VWP, RCRA; UIC); other:

Agency	Permit Type	Permit Number
VDEQ	VPA	VPA 01044
VDH-ODW	Transient non community water supply	PWSID 3001837 *permit being transferred to new owner
VDH-ODW	Transient non community water supply	PWSID 3001651 * permit being transferred to new owner
VDEQ	GWWP	Not yet issued

5. Nature of Business: The establishment is seasonally engaged in performing services on potatoes, subsequent to their harvest, with the intent of preparing them (via washing, disinfection and packaging) for further market distribution or processing.

SIC Code(s):	0723		

6. Type of Waste:

(check box as appropriate)	Proposed	Existing
Animal Waste (complete Form B)	☐	☐
Industrial Waste (complete Form C)	☐	☒
Land Application of Municipal Effluent (complete Form D, Part I)	☐	☐
Land Application of Biosolids/Sewage Sludge (complete Form D, Part II)	☐	☐
Reclamation and/or Distribution of Reclaimed Wastewater (Application Addendum)	☐	☐

VIRGINIA POLLUTION ABATEMENT PERMIT APPLICATION
FORM A
ALL APPLICANTS

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is to the best of my knowledge and belief true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations. I further certify that I am an authorized signatory as specified in the VPA Permit Regulation (9VAC25-32).

Signature:	Gerard B. Odell Jr.	Date: 3/11/14
Printed Name:	Gerard B. Odell, Jr.	
Title:	Chief Farming Officer, Kuzzens, Inc.	

VIRGINIA POLLUTION ABATEMENT

PERMIT APPLICATION

FORM C INDUSTRIAL WASTE

Department of Environmental Quality

Rev. 10-1995

VPA FORM C
INDUSTRIAL WASTE
INSTRUCTIONS

This form is to be completed by applicants requesting a VPA permit for industrial waste management systems. All industrial applicants must submit Part I of Form C. Part II must be submitted by applicants who use land application treatment systems for wastewater or sludge. In addition, certain industrial categories may be required to submit more information than this application requests. A preliminary meeting with the local DEQ Regional Office is recommended prior to completing any part of Form C.

PART C-I

1. **FACILITY NAME**: Name as given on Form A line 1.

2. **SOURCE OF WASTE**:

   a. The applicant should supply a short description of the specific manufacturing operation at the facility.

   b. A line drawing, in block diagram form, is to be furnished. Show the various steps or units of the manufacturing or processing operations, all points where industrial wastes or other wastes are produced, the volume of wastes generated at each location, and their method of disposal. List raw materials and show the points where they enter the process. Finished products and the points where they emerge from the process are also to be shown.

   c. Describe how sewage from employees is handled. (i.e., does it go to a septic tank/drainfield, local sanitary sewerage system, etc.).

   d. In the space provided, show the maximum and average hours/day and days/week of operation and the specific months of operation.

3. **NON-HAZARDOUS DECLARATION**: All industrial facilities must sign this declaration in order for the application to be complete. The signature must be in accordance with DEQ's Permit Regulation. The applicant should evaluate waste characteristics as required by Federal and State Regulations to determine if it is hazardous or non-hazardous (TCLP or other tests required by Department of Environmental Qualtiy). If identified as hazardous, it should be processed as a hazardous waste according to the requirements of RCRA and State Regulations through the Department of Environmental Quality.

4. **WASTE CHARACTERIZATION**: Waste characterization applies to waste being removed from the waste management system. For land application operations, analysis should be conducted on waste to be land applied. For proposed operations, estimates may be used based on the characteristics of similar facilities. Provide the references to identify the similar facility.

   The applicant is required to test for all parameters listed in 4.a. and/or 4.b., whichever group of parameters are appropriate. Should you feel that any of the required parameters are not appropriate for your operation, you may request in writing that the testing requirement be waived. The letter should accompany the VPA application when a submission is made. It must be pointed out that your waiver request should be reviewed with a DEQ Regional Office permit writer before the waiver is requested. Enough information must be available on characteristics of the waste to support issuance of the VPA permit. If the waiver request is denied, then the entire application package will be returned incomplete.

   DEQ places great importance on waste characterization. In Item 4.c., the applicant is requested to indicate if a parameter (not listed in 4.a. and/or 4.b.) is believed present or absent. If believed present, at least one analysis should be conducted. If the application is for both wastewater and sludge, make an additional copy of Part 4.c and

additional copy of Part 4.c and answer for both.

If the application is for a waste management system that uses recycling, the waste characterization may be substituted by supporting documentation, for example, MSDS sheets.

5. **POLLUTANT MANAGEMENT FACILIITES**: Provide a detailed flow chart in block diagram form showing the interrelation of all the treatment facilities. Include handling, treatment storage and disposal units in this chart. Recycle systems are also to be included for this application requirement.

OPERATIONS: Using the above flow diagram as a reference, describe the pollutant management operation of each unit and the system as a whole.

6. Please indicate the type and number of waste treatment units or storage facilities at your operation. Please also indicate if the facility is proposed or existing.

7. All waste treatment, storage facilities and land application sites must be approved by the Department of Environmental Quality. If the existing facilities have not been approved, it will be necessary to submit a conceptual engineering report. It is also suggested that you discuss this matter with a representative of a DEQ Regional Office before submitting the report.

8. If previously approved facilities have been expanded, a conceptual engineering report must be submitted to DEQ for approval for the expanded unit(s) as required by the application and instructions.

9. **CONCEPTUAL DESIGN**: Waste management facilities require technical expertise in the planning, design and construction phases of the project to insure that 1) the facility will meet the operational needs of the owner, 2) the facility is structurally sound and 3) the treatment system meets all necessary regulatory requirements. Detailed discussion of plans and specifications for the structural stability of the treatment works are beyond the scope of these instructions. Such expertise is available to owners through private engineering firms and Virginia universities. It should reemphasized that the structural integrity of all facilities is the responsibility of the owner.

Applicants should provide design information and/or calculations such as capacities, construction materials, flow directions, loading rates and water balance figures for the waste management structure and any associated piping and pumps. The following areas should be considered in preparing the conceptual design.

STORAGE/TREATMENT FACILITY CAPACITY: Facilities must be designed and operated to prevent point source discharge of pollutants to State waters except in the case of a 25 year-24 hour or greater storm event.

DEQ recommends the storage capacity be sufficient to ensure that wastes do not have to be applied to the land when the ground is ice or snow covered, too wet or during periods when fields are unavailable for waste utilization because of the cropping plan. A minimum 60-day storage capacity for wastewater or sludge is recommended to be designed into all pollution abatement facilities.

DEQ suggests that the storage facilities have a 2 ft. freeboard at all times.

GROUND WATER PROTECTION: Storage facilities and treatment works must be designed and operated to ensure compliance with the provisions of the Water Quality Standards for ground water. DEQ suggests that liners be installed in earthen storage facilities located in rapidly permeable soils (> 2.0 in/hr) or where Karst geology or shallow and fractured rock is encountered.

The Department of Environmental Quality requires lagoon liners to have a maximum coefficient of permeability of 1×10^{-6} cm/sec. It is recommended that soils used as liners be capable of achieving a maximum coefficient of permeability of 1×10^{-7} cm/sec or less. Total soil liner thickness should be one foot after compaction of two separate lifts of equal thickness.

Synthetic liners are preferred and should be a minimum of 20 mil. thickness, appropriate for the type wastewater, and be appropriately protected from puncture both below and above the liner. The liner should clearly be installed according to manufacturers specifications. Such specifications should also include recommendations, if any, for periodically inspecting the integrity of the liner.

A 2-foot separation distance between the facility bottom and the seasonal high water table is recommended.

WASTE VOLUMES: Accurate estimates of waste volumes are necessary to calculate properly sized waste holding and treatment facilities. Wastewater from contaminated storm water inputs to the pollution abatement facilities must also be considered, i.e., rainfall on to the facility surface and runoff from the surrounding roof and guttering systems.

10. **FLOOD POTENTIAL**: DEQ recommends that waste storage structures not be located on a floodplain unless protected from inundation or damage by a 100-year frequency flood event. Consult your local county zoning/planning office for information on flood plain locations and flood protection options. Such information may be available upon request.

11. Storm water runoff may be generated by parking lots, plant roofs or by the surrounding terrain. Proposed or existing facilities should be designed to contain the runoff from a 25 year 24 hour rain storm.

12. **LAND APPLICATION OF WASTES**: Facilities which land apply waste must complete Part C-II.

PART C-II

If instructions beyond those in the form are needed, contact the DEQ Regional Office for assistance.

VIRGINIA POLLUTION ABATEMENT PERMIT APPLICATION

FORM C

INDUSTRIAL WASTE

PART C-I General Information

1. Facility Name: Kuzzens-Mappsville North Packing Plant

2. Source(s) of Waste

a. *Provide a narrative which explains your facility operations and how wastes are produced.*

Historically, this facility has been used to process tomatoes. The new use will be for processing potatoes. Potatoes will be harvested and transported to the processing facility via farm trucks. The product will be dumped from the truck into a wash flume. The wash flume is filled with groundwater from an onsite well. Potatoes will be rinsed, sorted, graded and packaged for distribution. On average approximately 2,500 gallons per day of waste wash water is generated. Waste wash water is land applied to a cover crop for disposal.

b. *Attach a line drawing of the facility in block diagram for showing the manufacturing or processing operations and all points where wastes are produced.*

(See Appendix A - Figure 2)

c. *Explain how sewage from employees is handled (i.e., septic tank/drainfield,sanitary sewer etc.):*

Sanitary sewage from the packing house is treated by a septic tank and disposed through a drainfield located west of the packing house. The sewage system is wholly independent of the vegetable washing process wastewater disposal.

(See Figure 3)

d. *Operational Parameters*

Maximum hours/day of operation:	*12 / hours per day*
Average hours/day of operation:	*10/ per day of operation*
Days/week of operation:	*weather dependant 0 - 6*
Specific months of operation:	*June – July*

3. Non-Hazardous Declaration

a. *Statement for Plant Operations*

Is any part of the manufacturing operations, plant processes or waste treatment facilities at these plant facilities under the purview of the "Virginia Hazardous Waste Management Regulations" or the "Virginia Solid Waste Management Regulations?" _____ *Yes* _X_ *No.*

If Yes, please provide a brief explanation of the type of permit or requirements that apply.

NA

b. *For waste to be land applied, a responsible person, as defined by VR680-14-01, must sign the following statement.*

I certify that the waste described in this application is non-hazardous and not regulated under the Resource Conservation and Recovery Act.

Kenneth B. Adkins Jr. CFO Date 3/11/14

(Signature of Owner)

4. Waste Characterization

a. Wastewater - Provide at least one analysis for each parameter. Upon review, additional analyses may be required by DEQ. ***The system has been inactive (zero discharge) since the end of the 2009 operating period. Concentrations provided are either annual average from 2009 or as otherwise noted (*) derived from the 2002 permit renewal.***

Parameter	Concentration		Rationale for Requests
Flow to treatment	0.017	MGD	
Flow to storage	0.017	MGD	
Vol. to treatment	0.017	MG	
Vol. to storage	0.017	MG	
Vol. Land applied	0.96	MG/year	
BOD_5	*Request to be waived	mg/l	TOC/BOD/COD - waste water only contains
COD	*Request to be waived	mg/l	sediments and other inorganics therefore no TOC, BOD
TOC	*Request to be waived	mg/l	and COD.
TSS	To be provided	mg/l	
Percent Solids	To be provided	%	
PH	6.6	S.U.	
Alkalinity as $CaCO_3$	*Request to be waived	mg/l	Alkalinity - no substances that affect alkalinity will be
Nitrogen, (Nitrate)	2.1	mg/l	used.
Nitrogen, (Ammonium)	ND	mg/l	
Nitrogen, (Total Kjeldahl)	3.4	mg/l	
Phosphorus, (Total)	2.2	mg/l	
Potassium, (Total)	28.3	mg/l	
Sodium	*Request to be waived	mg/l	Sodium - no sodium containing substances used.
		mg/l	

b. Sludge - Provide at least one analysis for each parameter. Upon review, additional analyses may be required by DEQ. ***NA***

Parameter	Concentration*	
Percent Solids		%
Volatile Solids		%
pH		S.U.
Alkalinity as $CaCO_3$**		mg/kg
Nitrogen (Nitrate)		mg/kg
Nitrogen (Ammonium)		mg/kg
Nitrogen (Total Kjeldahl)		mg/kg
Phosphorous (Total)		mg/kg
Potassium (Total)		mg/kg
Lead		mg/kg
Cadmium		mg/kg
Copper		mg/kg
Nickel		mg/kg
Zinc		mg/kg
		mg/kg

Sludge is not generated at this site

* Unless otherwise noted, report results on dry weight basis.

** Lime treated sludges (l0% or more lime by dry weight) should be analyzed for percent $CaCO_3$.

c. *Provide a separate waste characterization listing for each wastewater and sludge generated at the facility. Insert "Yes" beside all parameters believed present and provide at least one analysis for each. Insert "No" beside all parameters believed not present. Indicate "NA" for any parameter already addressed in Item 4a. or 4b.*

→ The included data is from related operations from 2009. New data will be provided when it becomes available. (See Note #1) attached

Parameter	Believed Present (yes or no)	Concentration
Sodium	N/A	
Bromide	Yes	ND < 0.10 mg/L
Total Residual Chlorine	Yes	0.9 mg/L
Fecal Coliform	Yes	17 col. /100 ml
Fluoride	No	
Oil & Grease	Yes	ND < 5.0 mg/L
Total Radioactivity	No	
Total Alpha	No	
Total Beta	No	
Total Radium	No	
Total Radium 226	No	
Sulfate (as SO_4)	Yes	11.1 mg/L
Sulfide (as S)	No	
Sulfite (as SO_3)	No	
Surfactants	No	
Total Aluminum	No	
Total Barium	No	
Total Boron	Yes	0.06790 mg/L
Total Cobalt	No	
Total Iron	Yes	1.84 mg/L
Total Magnesium	Yes	4.510 mg/L
Total Molybdenum	No	
Total Manganese	Yes	0.2870 mg/L
Total Tin	No	
Total Titanium	No	
Total Antimony	No	
Total Arsenic	Yes	ND < 0.005 mg/L
Total Beryllium	Yes	ND < 0.001 mg/L
Total Cadmium	Yes	ND < 0.001 mg/L
Total Chromium	Yes	0.0094 mg/L
Total Copper	Yes	0.192 mg/L
Total Lead	Yes	ND < 0.005 mg/L
Total Mercury	No	
Total Nickel	Yes	0.0078 mg/L
Total Selenium	Yes	0.010 mg/L
Total Silver	Yes	ND < 0.005 mg/L
Total Thallium	Yes	ND < 0.001 mg/L
Total Zinc	Yes	0.1130 mg/L
Total Cyanide	No	
Total Phenols	No	
Dioxin	No	
Acrolein	No	

*If the analysis is for sludge, report results on dry weight basis.

c. (Continued)

Parameter	Believed Present (yes or no)	Concentration
Acrylonitrile	Yes	ND < 0.100 mg/L
Benzene	No	
Bis(Chloromethyl)Ether	No	
Bromoform	No	
Carbon Tetrachloride	No	
Chlorobenzene	No	
Chlorodibromomethane	Yes	ND < 0.010 mg/L
Chloroethane	No	
2-Chloroethylvinyl Ether	No	
Chloroform	Yes	1.180 mg/L
Dichlorobromomethane	No	
Dichlorodifluoromethane	No	
1,1-Dichloroethane	No	
1,2-Dichloroethane	No	
1,1-Dichloroethylene	No	
1,2-Dichloropropane	No	
1,3-Dichloropropylene	No	
Ethylbenzene	YES	To be provided
Methyl Bromide	No	
Methyl Chloride	No	
Methylene Chloride	No	
1,1,2,2-Tetrachlorethane	No	
Tetrachloroethylene	No	
Toluene	No	
1,2-TransDichloroethylene1	No	
1,1,-Trichloroethane	No	
1,1,2,-Trichloroethane	No	
Trichloroethylene	No	
Trichlorofluoromethane	No	
Vinyl Chloride	No	
2-Chlorophenol	No	
2,4-Dichlorophenol	No	
2,4-Dimethylphenol	No	
4,6-Dinitro-O-Cresol	No	
2,4-Dinitrophenol	No	
2-Nitrophenol	No	
4-Nitrophenol	No	
P-Chlor-M-Cresol	No	
Pentachlorophenol	No	
Phenol	No	
2,4,6-Trichlorophenol	No	
Acenaphthene	No	
Acenaphtylene	No	
Acenaphtylene	No	
Benzidine	No	
Benzo(a)Athracene	No	
Benzo(a)Pyrene	No	
3,4-Benzofluoranthene	No	
Benzo(ghi) Perylene	No	
Benzo(k)Fluoranthene	No	
Bis(2-Chloroethoxy)Methane	No	
Bis(2-Chloroethyl) Ether	No	
Bis(2-Chloroisopropyl)Ether	No	
Bis(2-Ethylhexyl)Phthalate	Yes	0.01360 mg/L
4-Bromophenyl Phenyl Ether	No	
Butyl Benzyl Phthalate	No	
4-Chlorophenyl Phenyl Ether	No	
2-Chloronaphthalene	No	
Chrysene	No	
Dibenzo(a,h) Anthracene	No	

c. (Continued)

Parameter	Believed Present (yes or no)	Concentration
1,2-Dichlorobenzene	No	
1,3-Dichlorobenzene	No	
1,4-Dichlorobenzene	No	
3,3'-Dichlorobenzidine	No	
Diethyl Phthalate	No	
Dimethyl Phthalate	No	
Di-N-Butyl Phthalate	No	
2,4-Dinitrotoluene	No	
2,6-Dinitrotoluene	No	
Di-N-Octyl Phthalate	No	
1,2-Diphenylhydrazine(as	No	
Azobenzene)	No	
Fluoranthene	No	
Fluorene	No	
Hexachlorobenzene	No	
Hexachlorobutadiene	No	
Hexachlorocyclopentadiene	No	
Hexachloroethane	No	
Indeno(1,2,3-cd)Pyrene	No	
Isophorone	No	
Naphthalene	YES	To be provided
Nitrobenzene	No	
N-Nitrosodimethylamine	No	
N-Nitrosodi-N-Propylamine	No	
N-Nitrosodiphenylamine	No	
Phenanthane	No	
Pyrene	No	
1,2,4 – Trichlorobenzene	No	
Aldrin	No	
ó- BHC	No	
β- BHC	No	
ɣ- BHC	No	
ь- BHC	No	
Chlordane	No	
4,4'- DDT	No	
4,4'- DDE	No	
4,4'- DDD	No	
Dieldrin	No	
ó -Endosulfan	No	
β –Endosulfan	No	
Endosulfan Sulfate	No	
Endrin	No	
Endrin Aldehyde	No	
Heptachlor	No	
Heptachlor Epoxide	No	
PCB – 1242	No	
PCB – 1254	No	
PCB – 1221	No	
PCB – 1232	No	
PCB – 1248	No	
PCB – 1260	No	
PCB – 1016	No	
Toxaphene	No	
Chloromethane	No	
Chlorpyrifos	No	
Demeton	No	
Dichloromethane	No	
(2,4-dichlorophenoxy) acetic	No	
acid (2,4-D)	No	
Di-2-Ethylhexyl Phthalate	No	
MBAS	No	

c. (Continued)

Parameter	Believed Present (yes or no)	Concentration
Lindane	No	
Hydrogen Sulfide Silvex	No	
Tributyltin	No	
Kepone Malathion Methoxyclor Mirex	No	
Monochlorobenzene	No	
Parathion	No	

d. Provide a separate waste characterization listing for each wastewater and sludge generated at the facility. List any additional parameters believed present in the spaces provided below and provide at least one analysis for each.

Parameter	Concentration
(See Full Parameter List in Appendix E)	

5. Briefly ~~describe the design~~ and provide a line drawing of the waste treatment facility which relates the various components of the treatment system including source(s), treatment unit(s), disposal alternatives, and flow estimates from the various process units.

(See Appendix A - Figure 2 + 4 and See Appendix F Note #2)

6. Indicate the number and type of waste storage facilities. If existing, indicate the volume; DEQ may require additional information upon review.

No.	Existing (Volume)	Proposed
___Earthen Storage Pond	_____	_____
___Storage Pit	_____	_____
2 Storage Tank	12,000 gallons	_____
___Anaerobic Lagoon	_____	_____
___Other	_____	_____
	_____	_____

7. Have the existing storage/treatment facilities identified in Item 5 and 6 above been previously approved by the Department of Environmental Quality?
Yes X No_____

If yes, provide the date of the approval and proceed to Item 8.
Approval Date: June 8, 1992

If no, provide information required by Items 9, 10, and II.

8. Have the previously approved facilities been altered or expanded?
Yes_____No X

If yes, it will be necessary to provide the information for such facilities, as required by Items 9 & 10, and 11.

If no, proceed to Item 12.

9. Provide conceptual design for the treatment facilities including design approach used. Explain how ground water will be protected. Demonstration should include soil evaluation, geology, hydrology, and topography. The following information must be provided for each proposed facility identified in Item 6 above and for those existing facilities in Items 7 and 8 which have not been either previously approved or were altered: **NA**

   a. *Design calculations for volume (ft^3) and estimated days of storage*

   b. *Description of lining material and permeability*

   c. *Plan and cross-sectional views*

   d. *Depth to seasonal high water table and separation to permanent water table.*

10. Will the proposed waste storage/treatment facilities be located within the 100-year flood plain? _____Yes _____No.

If yes, what is the elevation of the l00-year flood plain and elevation of the proposed facilities. Also, how will the waste storage facilities be protected from flooding? (Flood elevation can be obtained from your local county zoning/planning department).

NA

11. Will the proposed or existing storage/treatment facilities receive any storm water runoff? _____Yes _____No.

If yes, provide total area (square feet, acres, etc.) from which runoff will occur and indicate this area on the line drawing (Item 5). **NA**

Total area: _____
Dimensions: _____

12. Will any part of the waste generated at your facility be land applied? Yes _X_ No _____. If yes, Part C-II must be completed.

VIRGINIA POLLUTION ABATEMENT PERMIT APPLICATION

FORM C

INDUSTRIAL WASTE

PART C-II Land Application and Waste Handling Procedure

Facility Name: Mappsville North Packing Plant

Items 1-12 pertain to the land application of industrial sludge/wastewater at frequent and infrequent rates. The applicant may request a waiver in writing for any of the required information if it is not pertinent to their operation.

1. For each land application site provide a topographic map of sufficient scale (5 foot contour preferred) clearly showing the location of the following features within 0.25 mile of the site. Provide a legend with approximate scale. (See General Instructions for map requirements.)

(See Appedix A - Figures 1 and 3)

a. *Proposed or existing ground water monitoring wells*
b. *General direction of ground water movement*
c. *Water wells, abandoned or operating*
d. *Surface water*
e. *Springs (NA)*
f. *Public water supply(s)(Two found)*
g. *Sink holes (NA)*
h. *Underground and/or surface mines (NA)*
i. *Mine pool (or others) surface water dischargepoints (NA)*
j. *Mining spoil piles and mine dumps (NA)*
k. *Quarry(s) (NA)*
l. *Sand and gravel pits (NA)*
m. *m. Gas and oil wells (NA)*
n. *Diversion ditch(s) (NA)*
o. *Agricultural drainage ditch(s)*
p. *Occupied dwellings, including industrial and commercial establishments*
q. *Landfills or dumps (NA)*
r. *Other unlined impoundments (NA)*
s. *Septic tanks and drainfields*
t. *Injection wells*
u. *Rock outcrops (NA)*
v. *Soil boring or test pits locations (NA)*
w. *Subsurface drainage tile (NA)*

2. For each land application site provide a site plan of sufficient detail to clearly show any landscape features which will require buffer zones or may limit land application. Provide a legend and clearly mark the field boundaries and property lines. The following landscape features should be delineated. (See General Instructions for map requirements.) (See Appendix A - Figure 1)

   a. *Drainageways*
   b. *Rock outcrops*
   c. *Sink holes*
   d. *Drinking water wells and springs*
   e. *Monitoring wells*
   f. *Property lines*
   g. *Roadways*
   h. *Occupied dwellings*
   i. *Slopes (greater than 8% by slope class)*
   j. *Wet spots*
   k. *Severe erosion (SCS designation)*
   l. *Frequently flooded soils (SCS designation)*
   m. *Surface waters*

3. Provide a complete description of agronomic practices for each crop to be grown, on field-by-field basis including a nutrient management program, soil and/or plant tissue testing, and the coordination of tillage practices, planting and harvesting schedules and timing of land application.

   (See Appendix C)

4. Describe all land application methods and any equipment used in the process.

   (See Appendix A - Figure 4 and Appendix C)

5. Provide a detailed soil survey map, preferably photographically based, with the field boundaries clearly marked. (A USDA-SCS soil survey map should be provided, if available.)

   (See Appendix A - Figure 5)

   Provide a detailed legend for each soil survey map which uses accepted USDA-SCS descriptions of the typifying pedon for each soil series (soil type). Complex associations may be described as a range of characteristics. Soil descriptions should include the following information.

   a. *Soil symbol*
   b. *Soil series, textural phase and slope class*
   c. *Depth to seasonal high water table*
   d. *Depth to bedrock*
   e. *Estimated productivity group (for the proposed crop rotation).*
   f. *Estimated infiltration rate (surface soil)*
   g. *Estimated permeability of most restrictive subsoil layer*

   (See Appendix F)

6. Representative soil borings for frequent land application and fixed spray irrigations, (to no less than 5 ft. or to the water table) are to be conducted for the typifying pedon of each soil series (soil type) and the following data collected and tests performed. All results for infiltration and permeability tests should be enclosed. Provide information on the items below: **N/A**

Land application is seasonal so this requirement is not required for this site.

a. Soil symbol
b. Soil series, textural phase and slope class
c. Depth to seasonal high water table
d. Depth to bedrock (NA)
e. Estimated productivity group (for the proposed crop rotation).
f. Estimated infiltration rate (surface soil)
g. Estimated permeability of most restrictive subsoil layer

7. Representative soil samples are to be collected for each major soil type and analyzed for the soil parameters indicated on Page C-II.6. Samples are to be taken at a depth of 0-6 in.

(See Appendix B)

8. Land Area Determination:

a. Land area requirements are to be calculated and justified for each of the parameters listed below:

Parameters	*Method of Determining Required Area*
1. Nitrogen	*Crop uptake, immobilization denitrification, leaching*
2. Phosphorus	*Crop uptake, soil adsorption*
3. Potassium	*Crop uptake*
4. Sulfur	*Crop uptake, soil adsorption leaching*
5. Salts	*Sodium Adsorption Ratio (SAR), leaching*
6. Carbon/Nitrogen Ratio	
7. Metals(Ni, Cu, Zn, Pb, Co, Cd or other)	*Cumulative loading for site life*
8. Anions (As, B, Chlorides)	*Leaching, Soil Adsorption*
9. Calcium Carbonate Equivalency	*Soil pH management*
10. Other Parameters (As needed or as requested by DEQ)	

For each parameter and method of assimilation, (i.e. crop uptake, denitrification, immobilization, soil adsorption leaching, etc.), the required land area is to be justified by attaching calculations and appropriate references. Allowances for soil adsorption are to be justified by pertinent soil testing.

Provide calculations describing the nutrient value of the waste as lbs per dry ton or mg/l nitrogen (PAN), phosphorus (P_2O_5), potassium (K_2O), and any liming effects which may occur from land application.

b. *Land area requirements for application of industrial wastewater or liquid sludge are to be determined and an annual water balance on a monthly basis developed integrating the following factors:*

1. *Monthly precipitation*
2. *Monthly evapotranspiration data*
3. *Soil percolation rates (from subsurface permeability data)*
4. *Monthly wastewater loading*
5. *Monthly storage requirement*
6. *Monthly storage input/drawdown*

(See Appendix C)

9. Does the volume of wastewater generated as determined by the water balance in 8.b. exceed the hydraulic loading rate (inches/acre/year) of the soils? _____Yes __X__No

If Yes, explain how excess loading will be disposed of:

_____
_____
_____
_____
_____
_____
_____
_____

10. Is the land application site owned by the applicant? __X__Yes_____No.

If No, answer question 11 and have the land owner complete the authorization form, Page C-II-5.

11. Complete page C-II.5 by providing the name(s), address(es), site locations and signatures of non-applicant land owner on whose property industrial waste will be applied (A separate approval will be required for each additional owner.):

NA

AUTHORIZATION TO LAND APPLY WASTE

(Land Owner must sign and date this approval)

NA

As land owner, I authorize _____ to land apply wastewater/sludge to my property in accordance with their VPA Form C application. This authorization will remain in effect until such time as I notify the Department of Environmental Quality in writing that this authorization has been withdrawn.

Name: _____

Address: _____

_____

Telephone: _____

Site Location(s) _____

Date: _____

Signature: _____

SOIL TEST PARAMETERS FOR LAND APPLICATION SITES[1]

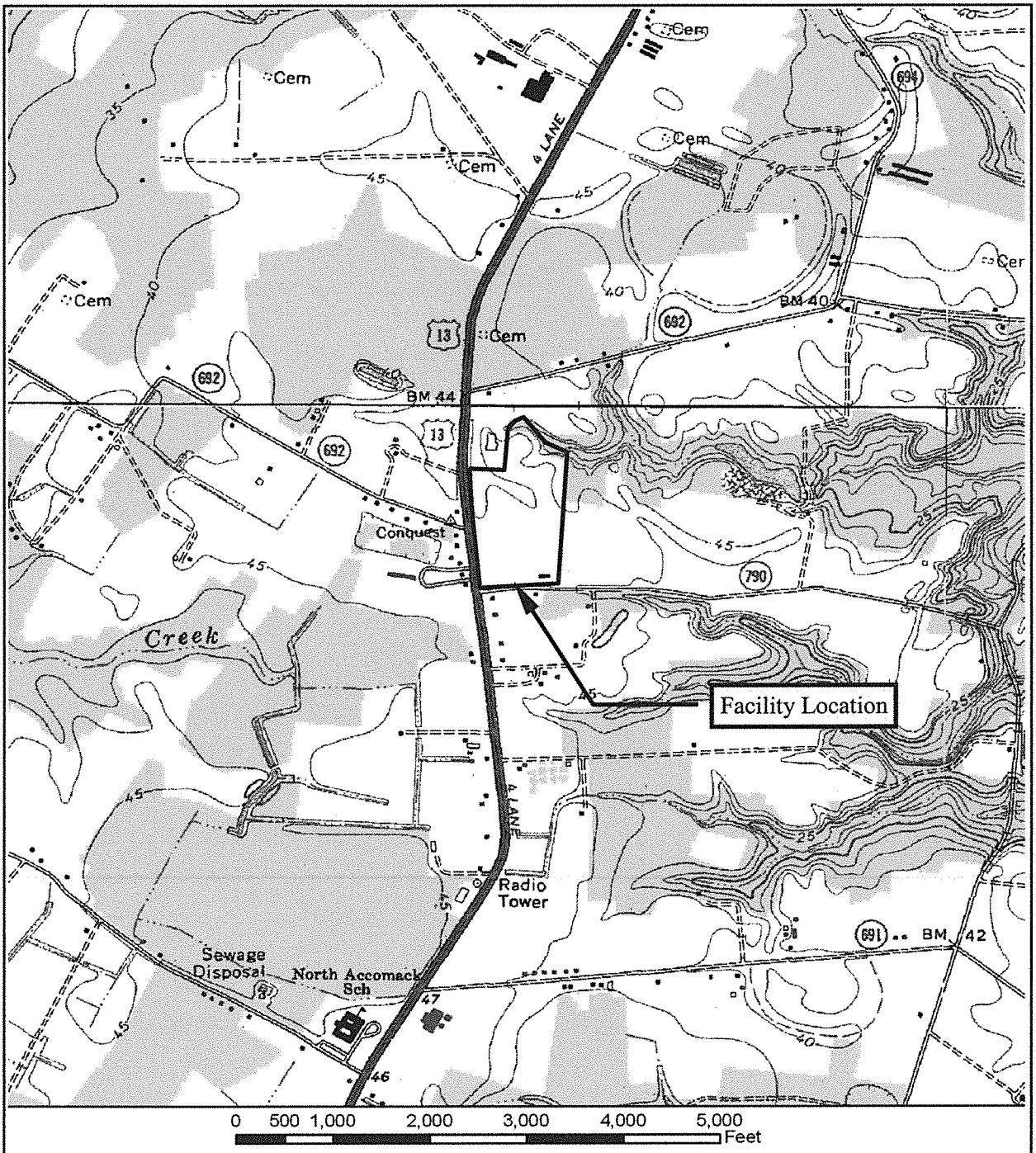
Parameter	Sludge – Frequent below Agronomic Rates[2]	Sludge - Frequent at Agronomic Rates[3]	Sludge - Infrequent	Wastewater
Soil Organic Matter (%)		*		*
Soil pH (Std. Units)	*	*	*	*
Cation Exchange Capacity (me/100g)	*	*	*	*
Total Nitrogen (ppm)		*		*
Organic Nitrogen (ppm)		*		*
Ammonia Nitrogen (ppm)		*		*
Nitrate Nitrogen (ppm)		*		*
Available Phosphorus (ppm)	*	*	*	*
Exchangeable Potassium (mg/100g)	*	*	*	
Exchangeable Sodium (mg/100g)		*		*
Exchangeable Calcium (mg/100g)		*		*
Exchangeable Magnesium (mg/100g)		*		*
Copper (ppm)		*		*
Nickel (ppm)		*		*
Zinc (ppm)		*		*
Cadmium (ppm)		*		*
Lead (ppm)		*		*
Chromium (ppm)		*		*
Manganese (ppm)		*		*
Particle Size Analysis or USDA Textural Estimate (%)		*		*
Hydraulic Conductivity (in/hr)				*

(1) Unless otherwise stated, analyses shall be reported on a dry weight basis.
(2) Less than 70% of agronomic nitrogen rates (annual basis).
(3) Test requirements will be adjusted based on previous test results.
* Test for these parameters.

APPENDICES:

Appendix A – Figures
Appendix B – Lab Results
Appendix C – Agronomic Practices
Appendix D – Calculations
Appendix E – Additional Notes
Appendix F – References

APPENDIX A
Figures



Source: Bloxom and Hallwood, Virginia USGS Quadrangle Topographic Maps

N

FIGURE 1. USGS TOPOGRAPHIC VICINITY MAP

KUZZENS- MAPPSVILLE NORTH PACKING PLANT
MAPPSVILLE, VIRGINIA

MSA JOB #	DATE:	SCALE	By:
08719AO	1/8/2014	Graphic	MME

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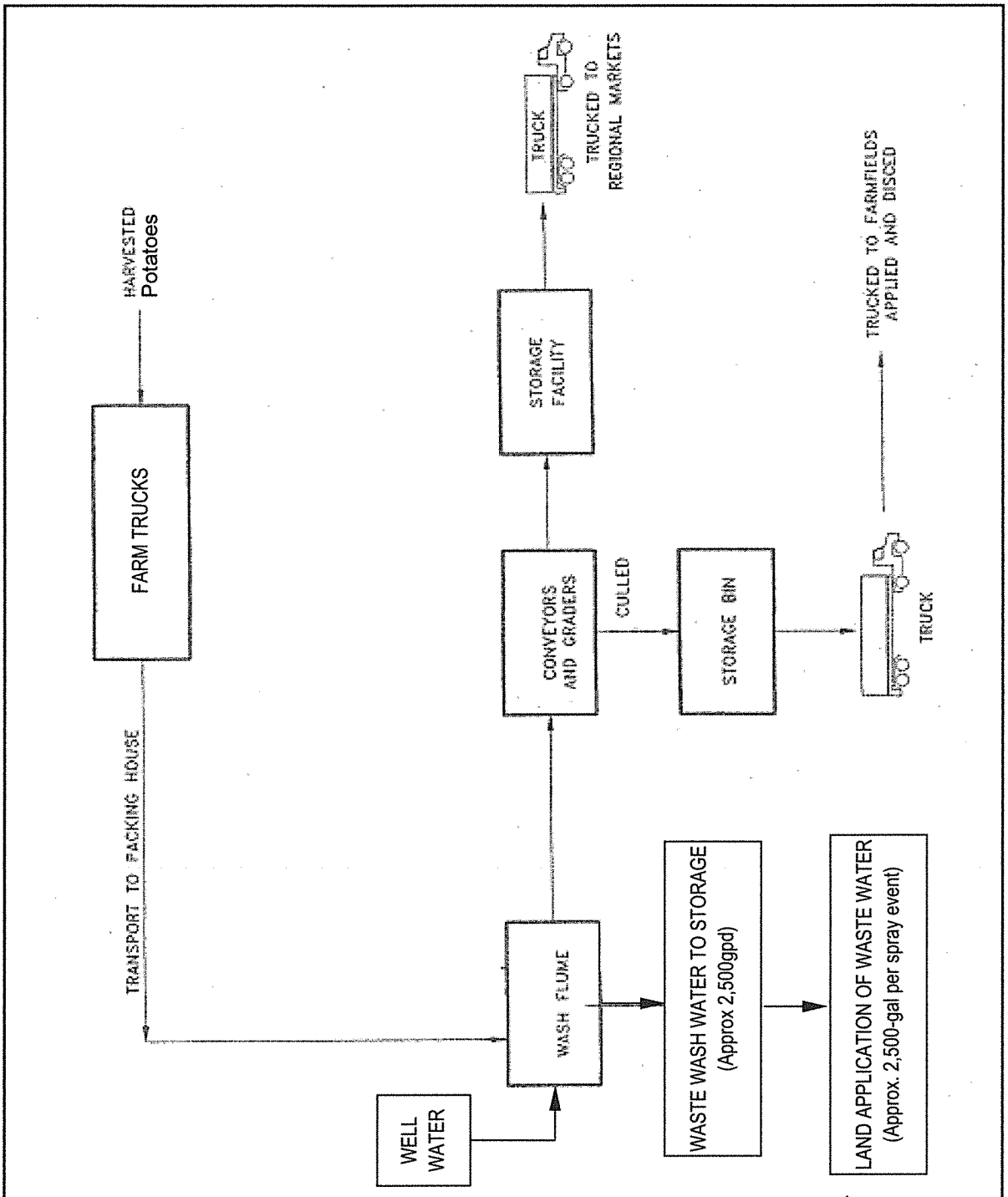

FIGURE 2. FACILITY SCHEMATIC & PROCESS LINE DRAWING

MSA JOB #	DATE:	SCALE	By:
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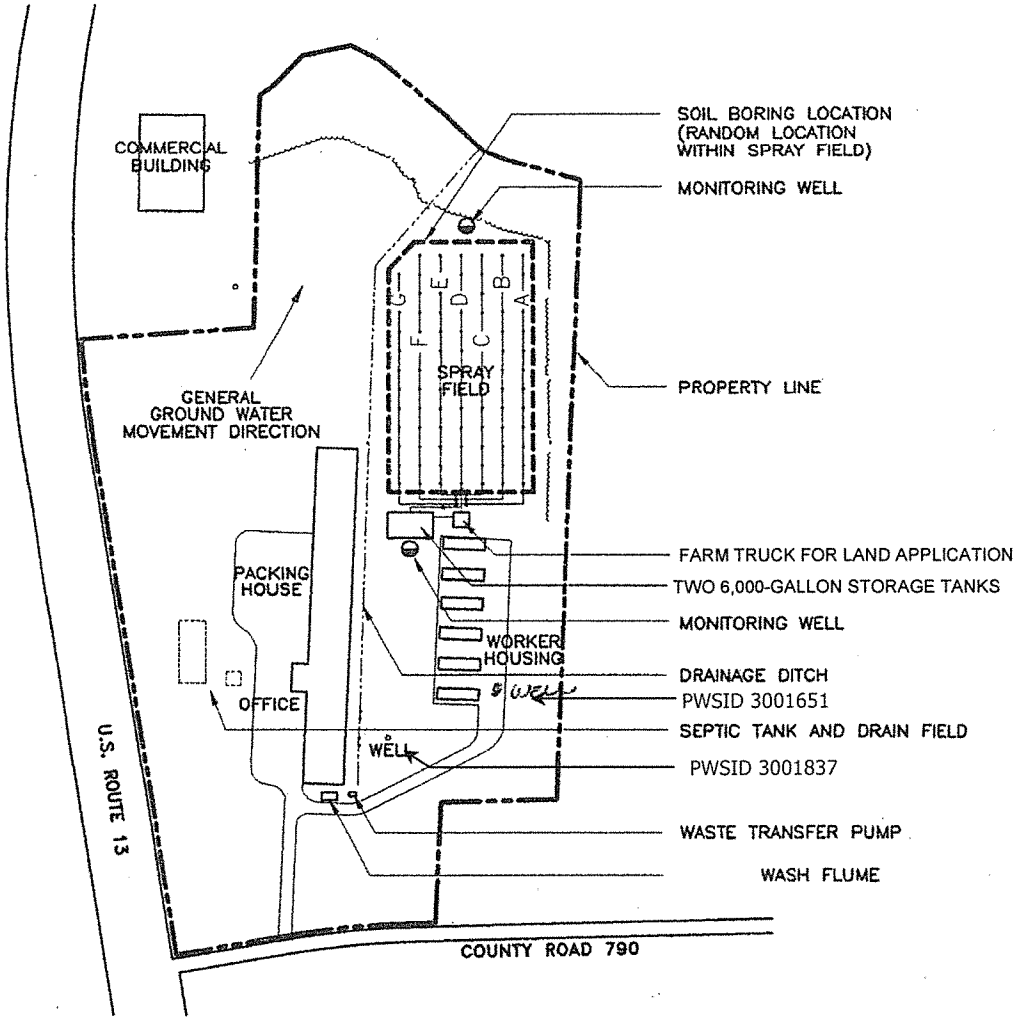

FIGURE 3. SITE FEATURES

KUZZENS- MAPPSVILLE NORTH PACKING PLANT
MAPPSVILLE, VIRGINIA

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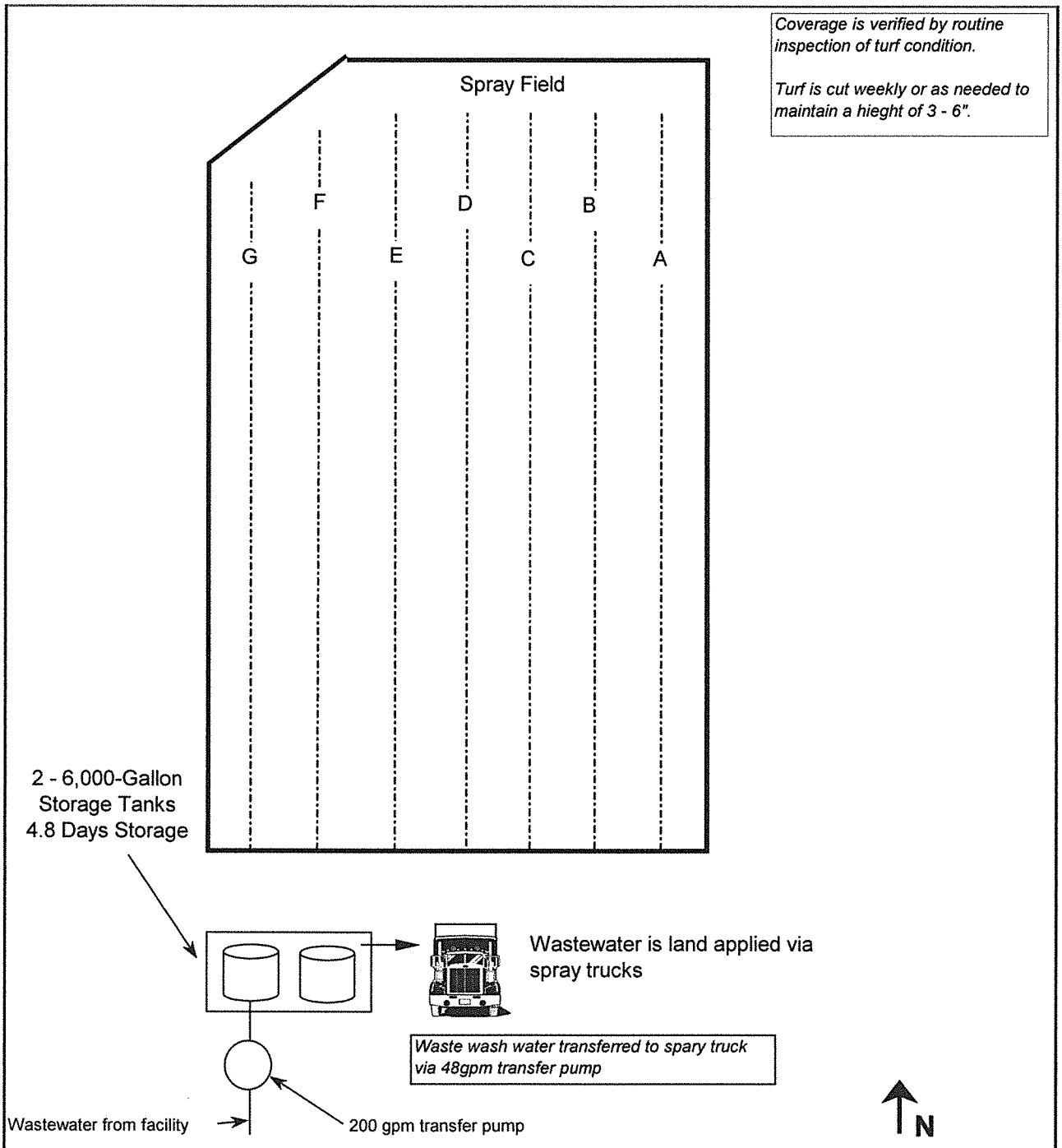

FIGURE 4. LAND APPLICATION METHODS

KUZZENS- MAPPSVILLE NORTH PACKING PLANT
MAPPSVILLE, VIRGINIA

MSA JOB #	DATE:	SCALE	By:
08719AO	1/8/2014	NTS	MME

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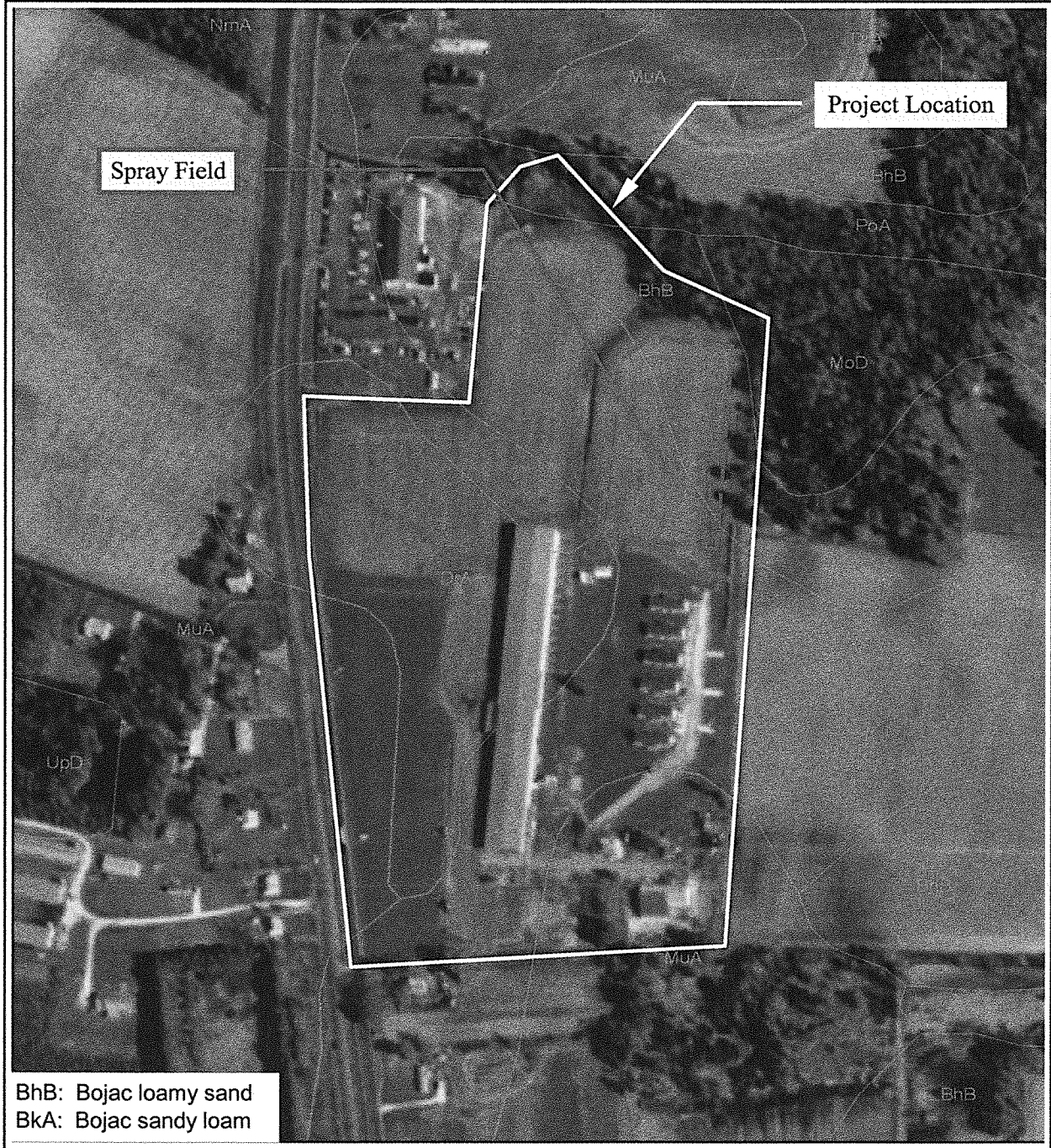

Note: Entire subject property is shown as in Flood Zone X on FEMA Flood Map 51001C0475F.

FIGURE 5. SOIL TYPES

MSA JOB #	DATE:	SCALE	By:
08719AO	1/8/2014	Graphic	BRO

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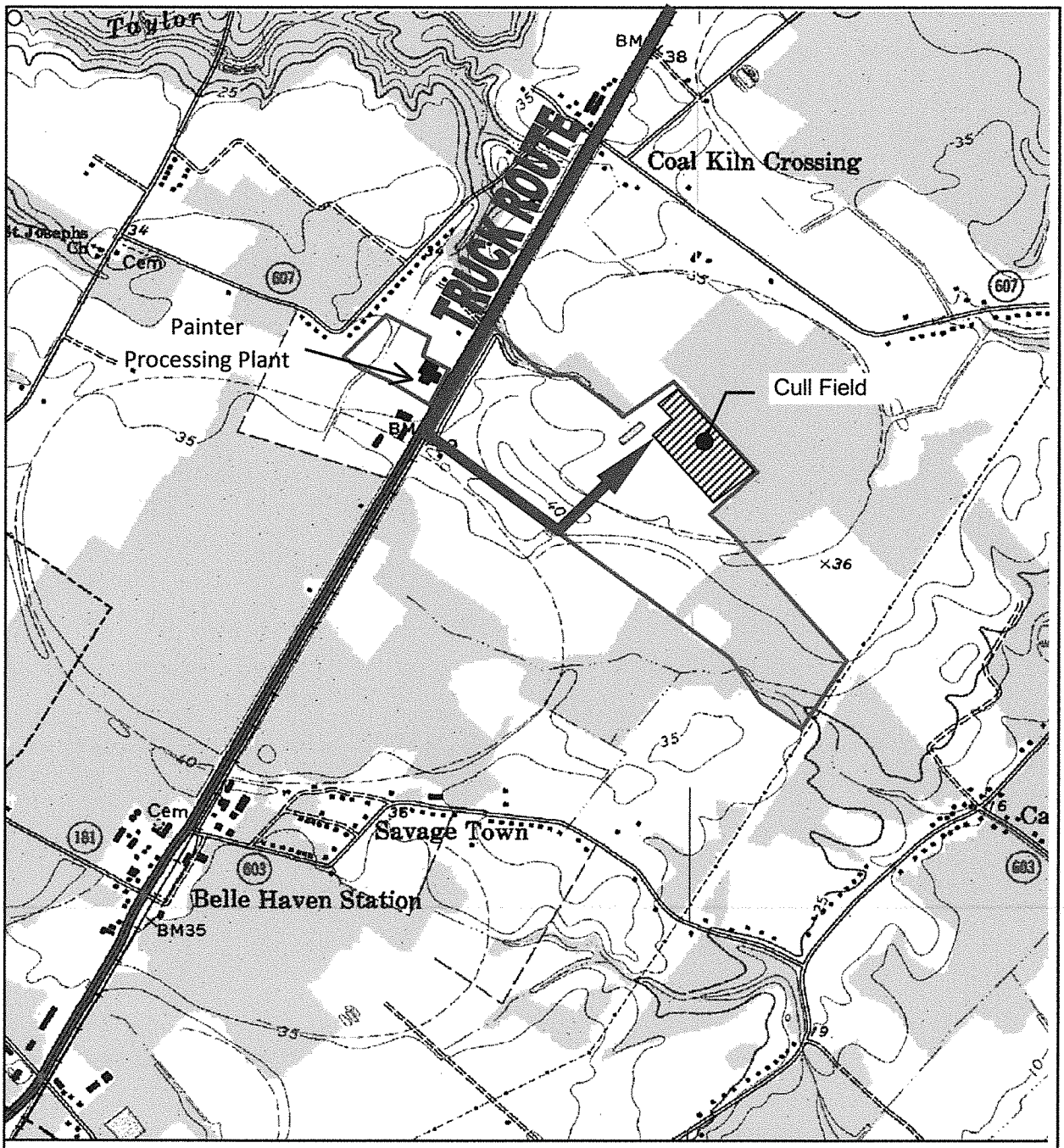

Source: Exmore, Virginia USGS Quadrangle Topographic Maps

N

FIGURE 6. CULL DISPOSAL SITE

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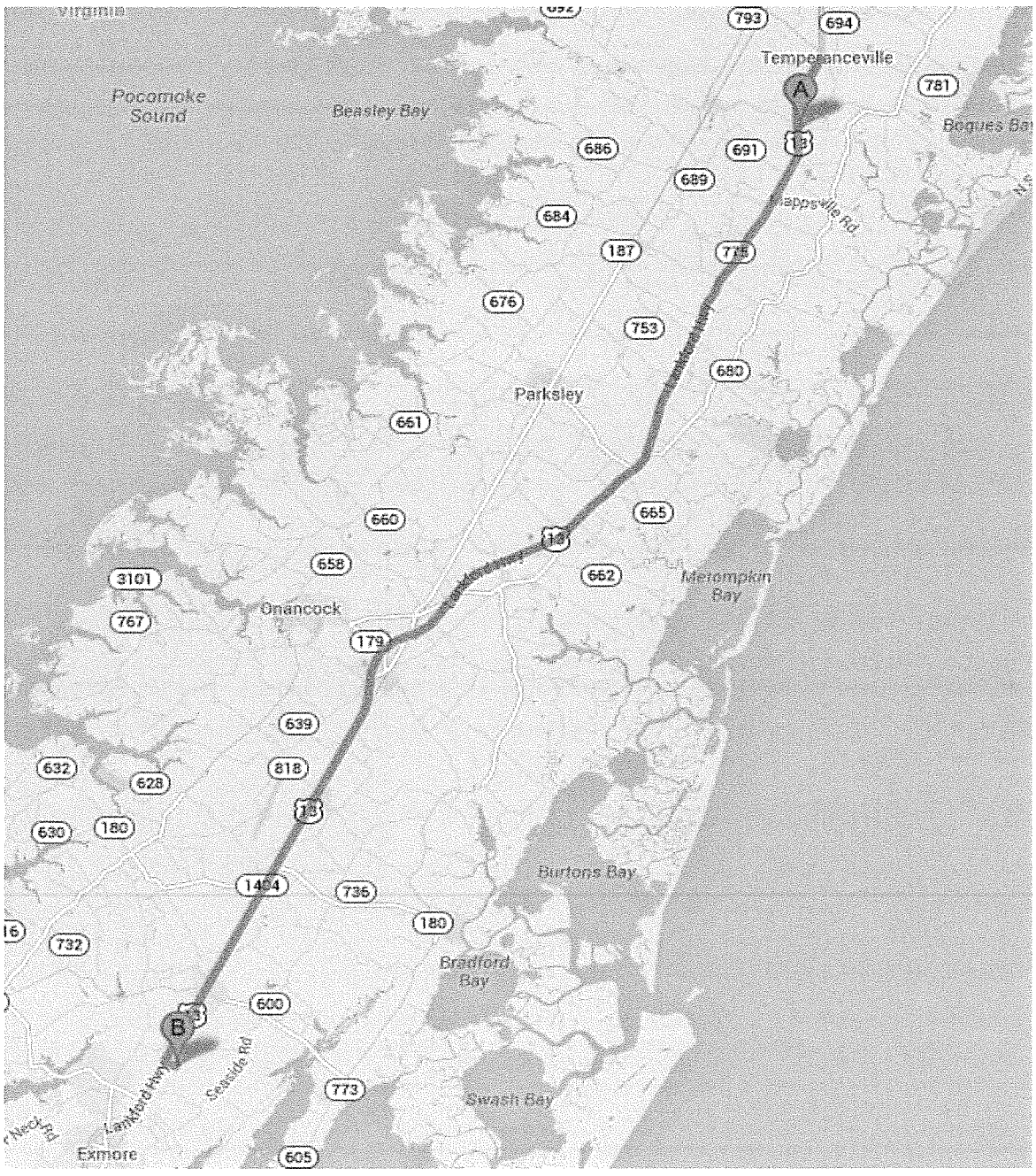

Source: Exmore, Virginia Google Maps

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FIGURE 7.
CULL DISPOSAL TRUCK ROUTE

MSA JOB #	DATE:	SCALE	By:
08719AO	1/22/2014	Graphic	MME

KUZZENS- MAPPSVILLE NORTH PACKING PLANT
MAPPSVILLE, VIRGINIA

MSA, P.C.
5033 Rouse Drive, Virginia Beach, VA. 23462
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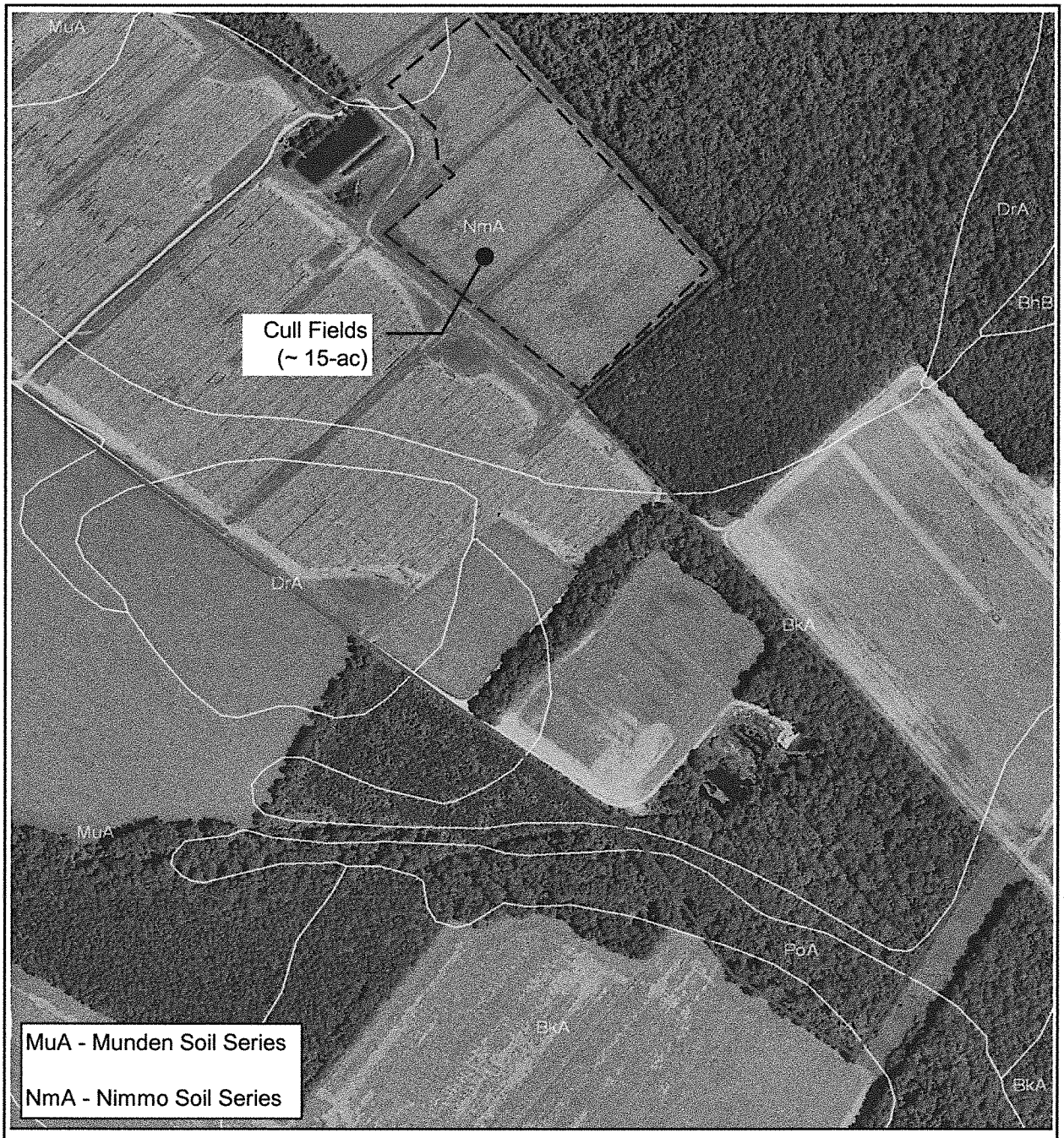

Source: 2011 Aerial Photograph from USDA-NAIP, Accomack, VA

Note: This entire area is shown as in Flood Zone X on FEMA Flood Map 51001C0800F

N

FIGURE 8. CULL FIELD SOIL TYPES

MSA JOB #	DATE:	SCALE	By:
08719AO	12/6/2011	As shown	BRO

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APPENDIX B
Lab Results

Report Number
14-073-0507 **Page:** 1 of 3

Account Number
06105

A&L Eastern Laboratories, Inc.

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Send To : MSA, PC
CHARLES HALL
5033 ROUSE DR
VIRGINIA BEACH , VA 23462

Client : KUZZENS INC²08719A0
MAPPSVILLE NORTH - PACKING

Submitted By : CHARLES HALL
Purchase Order :
Report Date: 3/21/2014
Date Received : 3/14/2014

REPORT OF ANALYSIS

Laboratory Number:	**01878**	**01879**
Sample Date And Time:		
Sample Identification:	BKA	BHB
Analysis:		
Nitrogen, Ammoniacal ,ppm SOIL AMMONIA-N	0.5	0.9
Nitrogen, Total (Inorganic + Organic) ,ppm CALCULATION	511	451
Organic N ,ppm CALCULATION	509.00	449.00
Total Cadmium ,ppm SW 6010C	< 2.0	< 2.0
Total Chromium ,ppm SW 6010C	< 5	5
Total Copper ,ppm SW 6010C	15	5
Total Kjeldahl Nitrogen ,ppm SM-4500-NH3C-TKN	510	450

Pauric McGroary

Pauric McGroary

Report Number
14-073-0507 **Page:** 2 of 3

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Client : KUZZENS INC²08719A0
MAPPSVILLE NORTH - PACKING

Submitted By : CHARLES HALL
Purchase Order :
Report Date: 3/21/2014
Date Received : 3/14/2014

REPORT OF ANALYSIS

Laboratory Number:	**01878**	**01879**
Sample Date And Time:		
Sample Identification:	BKA	BHB
Analysis:		
Total Lead ,ppm SW 6010C	< 5	5
Total Manganese ,ppm SW 6010C	44	67
Total Nickel ,ppm SW 6010C	< 5	< 5
Total Zinc ,ppm SW 6010C	7	6

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Report Number
14-073-0507 **Page:** 3 of 3

Account Number
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VIRGINIA BEACH , VA 23462

Client : KUZZENS INC²08719A0
MAPPSVILLE NORTH - PACKING

Submitted By : CHARLES HALL
Purchase Order :
Report Date: 3/21/2014
Date Received : 3/14/2014

REPORT OF ANALYSIS

Method Reference:
Calculation from lab derived data.

Methods of Soil Analysis, Part 3 - Chemical Methods, 2nd Ed. Rev. Soil Science Society of America, Black, C.A et al. 1982, pages 1129-1131.

Methods of Soil Analysis, Part 3 - Chemical Methods, 2nd Ed. Rev. Soil Science Society of America, Black, C.A et al. 1982, pages 1185-1186.

Standard Methods for the Analysis of Water and Wastewater, 1997

USEPA, SW-846, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, 3rd Ed. Current Revision

NITRATE, TN & ORG N NOT READY----ZERO IS NOT CORRECT RESULT 03/20/14

Pauric McGroary

Pauric McGroary

Report Number: 14-073-0507
Account Number: 06105

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Send To: MSA, PC
CHARLES HALL
5033 ROUSE DR
VIRGINIA BEACH VA 23462

Grower:
MAPPSVILLE NORTH - PACKING
KUZZENS INC
08719A0

Submitted By: CHARLES HALL
Farm ID: WW SPRAY

SOIL ANALYSIS REPORT

Analytical Method(s):
Mehlich 3

Date Received: 03/14/2014 **Date Of Analysis:** 03/17/2014 **Date Of Report:** 03/21/2014

Sample ID / Field ID	Lab Number	Organic Matter			Phosphorus		Potassium	Magnesium	Calcium	Sodium	pH		Acidity	C.E.C
		%	Rate	ENR lbs/A	Mehlich 3 ppm Rate	Reserve ppm Rate	K ppm Rate	Mg ppm Rate	Ca ppm Rate	Na ppm Rate	Soil pH	Buffer Index	H meq/100g	meq/100g
BKA	01878	1.6	L	76	160 VH		117 VH	77 H	576 M	15 VL	6.5		0.3	4.2
BHB	01879	1.9	L	82	88 H		82 M	84 H	557 M	16 VL	6.2		0.5	4.3

Sample ID / Field ID	Percent Base Saturation					Nitrate	Sulfur	Zinc	Manganese	Iron	Copper	Boron	Soluble Salts	Chloride	Aluminum
	K %	Mg %	Ca %	Na %	H %	NO_3N ppm Rate	S ppm Rate	Zn ppm Rate	Mn ppm Rate	Fe ppm Rate	Cu ppm Rate	B ppm Rate	SS ms/cm Rate	Cl ppm Rate	Al ppm
BKA	7.1	15.3	68.6	1.6	7.4	1									
BHB	4.9	16.3	64.8	1.6	12.1	1									

Values on this report represent the plant available nutrients in the soil. Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High). ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

Explanation of symbols: % (percent), ppm (parts per million), lbs/A (pounds per acre), ms/cm (milli-mhos per centimeter), meq/100g (milli-equivalent per 100 grams). Conversions: ppm x 2 = lbs/A, Soluble Salts ms/cm x 640 = ppm.

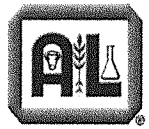
This report applies to sample(s) tested. Samples are retained a maximum of thirty days after testing.

Analysis prepared by: A&L Eastern Laboratories, Inc.

by: Pauric McGroary

Pauric McGroary

Report Number: 14-073-0507
Account Number: 06105



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VIRGINIA BEACH VA 23462

Grower:
MAPPSVILLE NORTH - PACKING
KUZZENS INC
08719A0

Submitted By: CHARLES HALL
Farm ID: WW SPRAY

Comments:

NITRATE, TN & ORG N NOT READY----ZERO IS NOT CORRECT RESULT 03/20/14

Nitrate-nitrogen analysis will detect levels no lower than 2 ppm nitrate-nitrogen. Results that indicate undetected levels of nitrate-nitrogen will display 2 ppm or 4 lb/acre.

"The recommendations are based on research data and experience, but NO GUARANTEE or WARRANTY expressed or implied, concerning crop performance is made."

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Pauric McGroary

Pauric McGroary

SOIL SAMPLE SUBMITTAL FORM

Account #
NEW

A&L Eastern Laboratories

7621 Whitepine Road · Richmond · VA 23237 Tel: 804-743-9401 Fax: 804-271-6446

E-mail: supportale@aleastern.com Website: www.aleastern.com

Grower/Project Information				Customer Information		
Mappsville North - Packing				Submitted By		Charge To
Kuzzens, Inc.				MSA, P.C. 5033 Rouse Dr. Va. Bch, VA 23462		same
0871940				Charles Hall		
Field ID	WW Spray	Farm ID		Copy to: ___Grower _X_ Submitter		
__ Master Card X Visa		Card # 4046 0111 9119 0839		Exp. Date: 03/15		Phone # 757-490-9264
E-mail address		charles.hall@msaonline.com				Crop Info For Recommendations

Sample ID	Lab Number (Lab Use Only)	S1M	S2M - Specify Additional Tests							S3M	Soluble Salts	Texture	NO_3-N	Additional Tests	Intended Crop	Yield Goal	Alternative Crop	Yield Goal	Previous Crop
			B	Cu	Fe	Mn	Na	S	Zn										
BkA														Attached					
BhB														Attached					

Mehlich III Test Packages

S1M - Organic matter, Phosphorus, Potassium, Calcium, Magnesium, pH, Buffer pH Cation Exchange Capacity, and % Base Saturation.

S2M - Test S1M plus any two of the following: Sodium, Sulfur, Boron, Zinc, Manganese, Iron, Copper. Each additional test (above two) cost $2.00.

S3M - Test S1M plus Sodium, Sulfur, Boron, Zinc, Manganese, Copper, and Iron.

Special Instructions or Additional Tests

See attached parameter list.

SOIL TEST PARAMETERS FOR LAND APPLICATION SITES[1]

Parameter	Sludge – Frequent below Agronomic Rates[2]	Sludge - Frequent at Agronomic Rates[3]	Sludge - Infrequent	Wastewater
Soil Organic Matter (%)		*		*
Soil pH (Std. Units)	*	*	*	*
Cation Exchange Capacity (me/100g)	*	*	*	*
Total Nitrogen (ppm)		*		*
Organic Nitrogen (ppm)		*		*
Ammonia Nitrogen (ppm)		*		*
Nitrate Nitrogen (ppm)		*		*
Available Phosphorus (ppm)	*	*	*	*
Exchangeable Potassium (mg/100g)	*	*	*	
Exchangeable Sodium (mg/100g)		*		*
Exchangeable Calcium (mg/100g)		*		*
Exchangeable Magnesium (mg/100g)		*		*
Copper (ppm)		*		*
Nickel (ppm)		*		*
Zinc (ppm)		*		*
Cadmium (ppm)		*		*
Lead (ppm)		*		*
Chromium (ppm)		*		*
Manganese (ppm)		*		*
Particle Size Analysis or USDA Textural Estimate (%)		*		*
Hydraulic Conductivity (in/hr)				*

(1) Unless otherwise stated, analyses shall be reported on a dry weight basis.
(2) Less than 70% of agronomic nitrogen rates (annual basis).
(3) Test requirements will be adjusted based on previous test results.
* Test for these parameters.

ENVIROCOMPLIANCE LABORATORIES, INC.

816 Kiwanis Street
Hampton, Virginia 23661
Phone 757 244 3424
Fax 757 244 3243

Analytical Summary

MSA, P.C.
Attn: Matt Reed
5033 Rouse Drive
Virginia Beach, VA 23462

Project No. : 08030B
Project Name : T/F - VPA
Date Received: September 05, 2008
Date Sampled : September 04, 2008
Time Sampled : 09:59
Date Issued : September 26, 2008

Lab # 1(A-F)/Sample ID : T&F

Parameter	Result	Units	DL	Date/Time Prepared	Date/Time Analyzed	Method	Analyst
Chloride	320	mg/l	1	09-11/1410	09-11/1445	4500CLC	PEJ
Nitrate (as N)	BDL	mg/l	2.5	09-05/1500	09-05/1500	4500NO3E	PEJ
Magnesium	14.92	mg/l	0.02	09-08/1145	09-16/1333	3111B	PEJ
Calcium	87.4	mg/l	0.2	09-08/1145	09-16/1435	3111B	PEJ
Sodium	191.9	mg/l	0.1	09-18/1203	09-18/1434	3111B	GBH
Available Phosphorus	4.3	mg/l	0.1	09-16/0800	09-16/1500	3120ICP	A&L
Exchangeable Potassium	64.6	mg/l	0.1	09-16/0800	09-16/1500	3120ICP	A&L
Dissolved Copper	2448	ug/l	2	09-18/1203	09-18/1434	3113B	GBH
Zinc	216	ug/l	50	09-09/1100	09-09/1419	3111B	PEJ
TKN	10.3	mg/l	0.1	09-16/1120	09-17/1000	4500NH3F	RAY
Ammonia (as N)	0.6	mg/l	0.1	09-16/0945	09-16/1100	4500NH3F	RAY
alpha-BHC	BDL	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
gamma-BHC	BDL	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
beta-BHC	BDL	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
Heptachlor	BDL	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
delta-BHC	BDL	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
Aldrin	BDL	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
Heptachlor epoxide	BDL	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
Endosulfan I	0.6	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
4,4'-DDE	BDL	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
Dieldrin	BDL	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
Endrin	0.4	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
4,4'-DDD	BDL	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
Endosulfan II	2.4	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
4,4'-DDT	BDL	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
Endrin aldehyde	BDL	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
Endosulfan sulfate	0.8	ug/l	0.1	09-17/1136	09-17/1136	8081A	TAC
Chlordane	BDL	ug/l	6.0	09-17/1136	09-17/1136	8081A	TAC

BDL = Below Detection Limit
All methods are 40 CFR 136 March 12, 2007, Table IB approved.
Reference to Standard Methods is 18th ed.

Annamarie E. McKinley
Laboratory Manager
H8922186-1

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Huntersville, NC 28078
(704)875-9092

ANALYTICAL RESULTS

Project: T&F VPA
Pace Project No.: 92103437

Sample: 1044 BOVAC **Lab ID: 92103437003** Collected: 09/28/11 14:45 Received: 09/29/11 15:25 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050							
Potassium	ND	mg/kg	566	1	10/06/11 13:30	10/07/11 19:55	7440-09-7	
Percent Moisture	Analytical Method: ASTM D2974-87							
Percent Moisture	**15.0**	%	0.10	1		10/03/11 08:47		
9045 pH Soil	Analytical Method: EPA 9045							
pH at 25 Degrees C	**6.7**	Std. Units	0.10	1		09/30/11 14:40		
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	**520**	mg/kg	40.0	1		10/13/11 10:00	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	**520**	mg/kg	15.9	1		10/11/11 15:07	7727-37-9	
353.2 Nitrogen, NO2/NO3	Analytical Method: EPA 353.2							
Nitrogen, Nitrate	ND	mg/kg	2.3	1		10/11/11 17:21		
Nitrogen, Nitrite	**1.5**	mg/kg	1.2	1		10/11/11 17:21		
Nitrogen, NO2 plus NO3	ND	mg/kg	2.3	1		10/11/11 17:21		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	**288**	mg/kg	22.6	5		10/11/11 10:19	7723-14-0	

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APPENDIX C
Agronomic Practices

I. TURF MAINTENANCE

Tall fescue grass is maintained on the spray field. The grass cover provides uptake of nutrients in the spray water, increases evapotranspiration and thus disposal of the water. The grass also provides erosion and sediment control to keep soils onsite. The grass and grass root matt also increase the detention time of the spray water in the topsoils where natural processes attenuate nutrients. No specific yield is anticipated from the cover crop as such tissue testing is not required.

Table 1 provides a summary of field maintenance.

Activity	Spring (April)	Summer	Fall (September)	Winter
Soils Sampling	X		X	
Aeration	X			
pH Amendment	X		X	
Pesticide (Weed) Application	X			
Cutting	X	X	X	
Irrigation		X	X	
Fertilizing			X	
Thatching			X	
Reseeding			X	

Soils are tested bi-annually (in April and September). During the April sampling event the turf is evaluated with respect to weed coverage. When coverage exceeds 25%, weed control is prescribed in keeping with best management practices. Specific product will be determined based on plant materials found to be present. Application will be in keeping with product labeling and best management practices.

The soil pH at land application sites shall be adjusted upward with lime, and if necessary downward with elemental sulfur, to achieve and maintain a pH range approximating 5.8 – 6.5 S.U.

Soil amendment with gypsum (calcium sulfate) at the rate of 10 to 15 lbs. per 100 sq. ft. shall be made on the spray application site in the spring if the Exchangeable Sodium Percentage (ESP) in the soil is equal to or greater than 15.

During the September sampling event the turf is evaluated with respect to health, density and thatch.

- If turf health is found to be substandard, amendments may be prescribed according to recommendations provided by A&L Eastern Laboratories, Inc. located in Richmond, Virginia. Amendments shall be applied according to recommendations and best management practices. To prevent brown patch nitrogen fertilizers shall be kept to a minimum.
- If turf is found to lack sufficient density the field is reseeding as per recommendations for reseeding of established turfs.

- Generally it is not necessary to thatch fescue turf however if the thatch matt is found to be inhibiting water penetration thatching will be prescribed followed by reseeding at the specified rate for established turfs.

During the active growing season the turf is cut on a weekly basis to maintain a turf height of 2.5 - 4". Spray application is monitored to ensure adequate coverage. Consistent coverage and the prevention of wet spots along with management of nitrogen is the primary control for brown patch.

II. NUTRIENT MANAGEMENT PLAN

A nutrient management plan (NMP) will be developed as soon as possible and approved for this facility and incorporated for use within the Agronomic Practices section in Appendix C.

III. SPRAY FIELD LAND APPLICATION METHODS AND EQUIPMENT

The method for land application of waste wash water used at this facility will be spray irrigation via truck mounted spreader rack. Upon the completion of each packing work day, a maximum of 2,500 gallons per day is spray irrigated. Wastewater is transferred from the storage tanks to a 3,600 gallon capacity spray truck using a 48gpm transfer pump.

Each 2,500gallon spray event will be applied to one of the seven spray field discharge lines (0.2inches depth). Each spray event will cover the next sequential spray field discharge line such that the entire field will be covered over the span of 7 spray events (7days). This provides approximately 1 week rest per discharge line. Application rates are adjusted by speed of the spray trucks.

Over application is prevented by the operator visually inspecting and walking on the spray field to verify that the field appears dry enough to receive the wastewater. If the field appears to be wet, no spraying will be performed. The current volume application volume is small enough that the buffers are not needed.

Truck mounted spreader rack systems are very reliable for spray irrigation systems in that they are simple and have few parts. Since the facility will not use an irrigation system of piping, valves, controllers, and pumps, it will be less complicated and not require significant spare parts and equipment. In the event that a spray truck becomes in need of repair, or during wet periods when spraying cannot occur, the 12,000 gallon storage capacity is used to hold excess wastewater until it can be applied. If the transfer pump goes down, one-half of the volume of the vertical storage tanks can still gravity drain into the trucks providing at least 6000-gallons of holding capacity. For longer duration mechanical problems with the spray truck, a backup spray truck from another spray irrigation operation will be used. Since the spray field has excess capacity, the application rate can be increased so that the truck will have sufficient time between spray events at the two facilities.

IV. CULL DISPOSAL

Culls are defined as product that is not fit for wholesale distribution. Product is determined to be a cull when its size falls outside of customer criteria (either too large or too small), is physically defective (malformed, damaged, or ruptured) or is over ripe for packaging. The daily amount of culls produced will vary depending upon current quality of potatoes, customer requirements, and rate of harvest; all of which are unknown at this time.

Although unrelated to wastewater disposal, potato culls removed from the processing operation will require their own disposal. Culls separated from marketable product after the washing process and are loaded onto a spreader truck for hauling to an offsite cull disposal field (see Figures 6 and 7).

The cull disposal area consists of three small fields encompassing approximately 15-acres on Nimmo and Munden soil series suitable for the purpose. These fields have historically been used for disposal of culled tomatoes without any problems.

Kuzzens, Inc.
Mappsville North Packing Plant

VPA Permit Application
VPA 01044

Appendix III
Technical Soil Descriptions

BkA—Bojac sandy loam, 0 to 2 percent slopes

Setting

Landform: Stream terraces
Landscape position: Nearly level and undulating surfaces
Size of areas: 5 to 1,200 acres

Composition

Bojac and similar soils: 85 to 95 percent
Dissimilar inclusions: 5 to 15 percent

Inclusions

Dissimilar inclusions:
• Dragston soils, which have a grayer subsoil than the Bojac soil; on the rims of depressions, on flats, and in depressions

Similar soils:
• Soils that have about 2 to 15 percent gravel in the subsoil and about 5 to 50 percent gravel in the substratum; in landscape positions similar to those of the Bojac soil

Typical Profile

0 to 7 inches—brown sandy loam
7 to 27 inches—strong brown loam
27 to 33 inches—strong brown sandy loam
33 to 40 inches—strong brown loamy sand
40 to 85 inches—pale brown sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid
Available water capacity: Low
Organic matter content: Low
Soil reaction: Extremely acid to slightly acid in the surface layer and subsoil, very strongly acid to moderately acid in the substratum
Natural fertility: Low
Surface runoff: Slow
Hazard of water erosion: Low
Hazard of wind erosion: Medium
Depth to water table: 48 to 72 inches
Root zone: More than 60 inches
Shrink-swell potential: Low
Corrosivity: To concrete—high; to steel—low

Use and Management

Cropland

Suitability for cultivated crops: Well suited
Suitability for nursery crops: Well suited (fig. 7)
Management concerns:
• Droughtiness, which can be overcome by applying irrigation water
• The hazard of wind erosion, which can be reduced by establishing windbreaks, leaving plant residue on the surface, and using a conservation tillage system
• Low content of organic matter, which can be increased by incorporating plant residue into the soil

Pasture

Suitability for grasses and legumes: Well suited
Management concerns:
• Droughtiness, which can be overcome by applying irrigation water

Woodland

Potential productivity for loblolly pine: High
Site index for loblolly pine: 80
Estimated annual production of loblolly pine: 115 cubic feet per acre
Management concerns:
• No major concerns

Septic tank absorption fields

Suitability: Well suited
• Seasonal wetness, which can be reduced by placing the absorption field above the high water table

Building sites

Suitability: Well suited
Management concerns:
• Sloughing, which can be prevented by shoring excavation walls
• Wetness, which can be reduced by installing a drainage system
• Droughtiness, which can be overcome by applying irrigation water

Recreational areas

Suitability: Well suited
Management concerns:
• No major concerns

Interpretive Groups

Land capability classification: IIs
Woodland ordination symbol: 8A

Munden Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately rapid in the subsoil, moderately rapid or rapid in the substratum
Parent material: Unconsolidated sediments
Slope range: 0 to 2 percent

Typical Pedon

Munden sandy loam, 0 to 2 percent slopes, 0.8 mile south-southeast of the junction of Virginia Highways 658 and 682 and 1.2 miles west-southwest of the junction of Virginia Highways 681 and 316, near Bloxom:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) sandy loam; weak medium granular structure; friable, slightly sticky and slightly plastic; common fine and medium roots; very strongly acid; clear smooth boundary.

Bt1—8 to 20 inches; yellowish brown (10YR 5/6) loam; common medium distinct reddish yellow (7.5YR 6/8) mottles; weak medium subangular blocky structure; friable, sticky and slightly plastic; common fine and medium roots; many distinct clay bridges between sand grains; few faint clay films in pores; very strongly acid; gradual smooth boundary.

Bt2—20 to 25 inches; yellowish brown (10YR 5/6) sandy loam; common medium distinct reddish yellow (7.5YR 6/8) and pale brown (10YR 6/3) mottles; weak medium subangular blocky structure; friable, sticky and slightly plastic; few fine roots; many distinct clay bridges between sand grains; few faint clay films in pores; very strongly acid; gradual smooth boundary.

Bt3—25 to 40 inches; yellowish brown (10YR 5/6) sandy loam; many medium distinct reddish yellow (7.5YR 6/8) and light gray (10YR 7/2) mottles; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; many distinct clay bridges between sand grains; few faint clay films in pores; very strongly acid; gradual smooth boundary.

C—40 to 55 inches; mottled pale brown (10YR 6/3) and grayish brown (10YR 5/2) loamy sand; single grain; loose; strongly acid; gradual smooth boundary.

Cg—55 to 85 inches; grayish brown (10YR 5/2) fine sand; single grain; loose; strongly acid.

Range in Characteristics

Thickness of the solum: 25 to 45 inches
Soil reaction: Very strongly acid to moderately acid
Content of coarse fragments: 0 to 5 percent

Ap horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—1 to 4
Texture—loamy sand, loamy fine sand, sandy loam, fine sandy loam, or loam

Upper part of the Bt horizon:
Hue—7.5YR to 2.5Y
Value—3 to 6
Chroma—4 to 8
Texture—sandy loam, fine sandy loam, or loam

Lower part of the Bt horizon:
Hue—7.5YR to 2.5Y
Value—3 to 6
Chroma—3 to 8
Texture—sandy loam, fine sandy loam, or loam

Btg horizon (not in all pedons):
Hue—7.5YR to 2.5Y or neutral
Value—3 to 6
Chroma—0 to 2
Texture—sandy loam, fine sandy loam, or loam; subhorizons of sandy clay loam

C horizon:
Hue—7.5YR to 5Y
Value—5 to 7
Chroma—3 to 8
Other features—mottles that have chroma of 0 to 8
Texture—sand, fine sand, loamy sand, loamy fine sand, sandy loam, or fine sandy loam

Cg horizon:
Hue—7.5YR to 5Y or neutral
Value—5 to 7
Chroma—0 to 2
Texture—sand, fine sand, loamy sand, loamy fine sand, sandy loam, or fine sandy loam

MuA—Munden sandy loam, 0 to 2 percent slopes

Setting

Landform: Coastal-plain uplands and stream terraces
Landscape position: Nearly level surfaces
Size of areas: 5 to 300 acres

Composition

Munden and similar soils: 85 to 95 percent
Dissimilar inclusions: 5 to 15 percent

Inclusions

Dissimilar inclusions:
- Nimmo soils, which have a grayer subsoil than the Munden soil; on flats and in depressions

Similar soils:
- Seabrook soils, which have a sandier subsoil than the Munden soil; in landscape positions similar to those of the Munden soil
- Soils that have about 5 to 35 percent gravel in the subsoil and substratum; in landscape positions similar to those of the Munden soil

Typical Profile

0 to 8 inches—dark grayish brown sandy loam
8 to 20 inches—yellowish brown loam
20 to 25 inches—yellowish brown sandy loam that has reddish yellow and pale brown mottles
25 to 40 inches—yellowish brown sandy loam that has reddish yellow and light gray mottles
40 to 55 inches—mottled pale brown and grayish brown loamy sand
55 to 85 inches—grayish brown fine sand

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately rapid in the subsoil, moderately rapid or rapid in the substratum
Available water capacity: Low
Organic matter content: Low
Soil reaction: Very strongly acid to moderately acid
Natural fertility: Low
Surface runoff: Slow
Hazard of water erosion: Low
Hazard of wind erosion: High
Depth to water table: 18 to 30 inches
Root zone: More than 60 inches
Shrink-swell potential: Low
Corrosivity: To concrete—high; to steel—low

Use and Management

Cropland

Suitability for cultivated crops: Well suited
Suitability for nursery crops: Well suited (fig. 12)
Management concerns:
- Wetness early in the growing season, which can be reduced by installing a drainage system
- Droughtiness later in the growing season, which can be overcome by applying irrigation water
- Low content of organic matter, which can be increased by incorporating plant residue into the soil

Pasture

Suitability for grasses and legumes: Well suited
Management concerns:
- Wetness

Woodland

Potential productivity for loblolly pine: Very high
Site index for loblolly pine: 90
Estimated annual production of loblolly pine: 130 cubic feet per acre
Management concerns:
- Wetness

Septic tank absorption fields

Suitability: Moderate
Management concerns:
- Wetness, which can be reduced by placing the absorption field above the level of the seasonal high water table
- Poor filtering capacity, which can be overcome by increasing the size of the field

Building sites

Suitability: Well suited
Management concerns:
- Sloughing, which can be prevented by shoring excavation walls
- Wetness, which can be reduced by installing a drainage system
- Droughtiness, which can be overcome by applying irrigation water

Recreational areas

Suitability: Well suited
Management concerns:
- Wetness, droughtiness

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 9W

EXHIBIT

APPENDIX D
Calculations

Calculations are based on the following parameters:

- The subject spray field is 3.39 acres
- Primary soils are Bojac series with a slope of 0 – 2 (BkA and BhB).
- The "crop" is a year round permanent stand of tall fescue.
- Soil samples collected September 2011. Soil analyses are expressed as dry weights in mg/kg.

System has been idle since 2009 therefore the 2009 annual summary of spray water analysis and historic analysis for the 2002 application are utilized. Water analyses are expressed as mg/L.

MSA, P.C.

ENVIRONMENTAL SCIENCES, PLANNING, SURVEYING, & ENGINEERING

Taylor and Fulton

2009 Chloride Loading: VPA# 01044

DATE:	GRID SCALE:	MSA JOB #:
2009	H: -- V: --	**08030B**

Table 1. Calculation of chloride loading to irrigation field.

Annual volume of wastewater applied to irrigation field (G)	219,017
Annual volume of wastewater applied to irrigation field (MG)	0.219
Area of irrigation field (ac)	3.39
Depth of wastewater applied (in)	2.4
Annual depth of precipitation (in)	42
Annual evapotranspiration (in)	32
Excess precipitation (in/yr)	10
Volume of excess precipitation over irrigation field (MG)	0.920
Chloride in wastewater July (mg/L)	385
Chloride in wastewater August (mg/L)	130
Chloride in wastewater September (mg/L)	320
Chloride in wastewater October (mg/L)	0
Average concentration of wastewater chloride for season (mg/L)	278.2
Chloride applied to irrigation field (lbs/ac/yr)	185
Total chloride applied to irrigation field (lbs/yr)	626
Chloride available for plant uptake (lbs)	0
Chloride load to irrigation field (lbs/yr)	626
Chloride in leachate(mg/L)	65.76
Dilution rate of wastewater chloride	76%

APPENDIX E
Additional Notes

Kuzzens, Inc.
Mappsville North Packing Plant

VPA Permit Application
VPA 01044

Appendix V
Land Area Determination

section will be updated when current data becomes available.

Appendix V
Land Area Determination

GENERAL:

Calculations are based on the following parameters:

- The subject spray field is 3.39 acres
- Primary soils are Bojac series with a slope of 0 – 2 (BkA).
- The "crop" is a year round permanent stand of tall fescue.
- Soil samples collected September 2011. Soil analyses are expressed as dry weights in mg/kg.
- System has been idle since 2009 therefore the 2009 annual summary of spray water analysis and historic analysis for the 2002 application are utilized. Water analyses are expressed as mg/L.

VPA 01044

Available land	3.39
2009 total Flow	0.22 MG

Nitrogen Balance

	Results	*as mg/L*	Flow	*as Liters*	Loading
NH3	36.10	0.0361	220,000	832790.59	30.06
TKN	70.5	0.0705	220,000	832790.59	58.71
NO3	2.5	0.0025	220,000	832790.59	2.08
NO2	0.01	0.0000	220,000	832790.59	0.01

Total N Applied	sum of balance	90.87	
20% N loss through denitrification	sum X .2	18.17	
Available N	Total - loss	72.69	
Uptake for Fescue	ncsu pub	135.00	
Acres Required	available / uptake	**0.54**	**Acers**

Given application rates for N are well below the uptake potential of the cover crop leaching was not discussed.

Phosphorus Balance

	Results	*as mg/L*	Flow	*as Liters*	Loading	
P	7.20	0.0072	220,000	832790.59	6.00	
Uptake for Fescue				ncsu pub	65.00	
Acres Required				available / uptake	**0.09**	**Acers**

Given application rates for P are well below the uptake potential of the cover crop leaching was not discussed.

Potasium Balance

	Results	*as mg/L*	Flow	*as Liters*	Loading	
K	76.20	0.0762	220,000	832790.59	63.46	
Uptake for Fescue				ncsu pub	185.00	
Acres Required				available / uptake	**0.34**	**Acers**

Sulfur Balance

	as mg/L	Flow	*Load*	
Sulfate	254	500,000	1059.00	lb/year
Sulfur content			353.00	lb/year
Uptake for Fescue			102	lbs
Residual			**251**	**lbs**
Sulfate available for leaching			786	lb/year
Precipitation			42.69	in/year
Evapotranspiration			31.6	in/year
Exess Precipitation			11.09	in/year
over 3.39 Acres			1.021	MG/year
wastewater applied			0.5	MG/year
Total			1.521	MG/year
Concentration of sulfate in leachate			**61.92**	**mg/L**

Sulfur was not tested for due to facility inactivity. Data and calculations as prepared by Cabe Associates for the 2002 VPA Application are presented as a reference.

Salt Balance

	Results	*as mg/L*	Flow	*as Liters*	Loading	mmol
Na	321.25	0.3213	220,000	832790.59	267.53	11.6319
Ca	83.4	0.0834	220,000	832790.59	69.45	3.47274
Mg	12.92	0.0129	220,000	832790.59	10.76	0.89664
SAR	(Na/23)/(SQRT(0.5 X ((Ca/20)+(Mg/12))))				**9.32**	

Carbon / Nitrogen Balnce

TOC	245.5		
TKN	27.1		
C/N ratio		TOC / TKN	**9.06**

Note: *The facility has been inactive since 2009. Given that the spray field have been idle the carbon / nitrogen balance would not be indicative of an active field therefore data from the 2002 application has been submitted.*

LAND REQUIREMENTS FOR METALS

Copper	mg/L	*mg/Gal*	lb/Gal	*Flow*	Mass Applied	lb/Acre	
	0.64	2.4224	5.34139E-06	220000	1.17510624	0.35	
	Cumulative Limt (lb/acre)				*permit*	125	
	Land Needed				loading / limit	0.009	
	Site Life				lb/Acre/permit	**361**	**Years**
Zinc	mg/L	*mg/Gal*	lb/Gal	*Flow*	Mass Applied	lb/Acre	
	0.34	1.2869	2.83761E-06	220000	0.62427519	0.18	
	Cumulative Limt (lb/acre)				*permit*	250	
	Land Needed				loading / limit	0.002	
	Site Life				lb/Acre/permit	**1358**	**Years**
Nickel *	mg/L	*mg/Gal*	lb/Gal	*Flow*	Mass Applied	lb/Acre	
	0.01	0.03785	8.34593E-08	500000	0.041729625	0.01	
	Cumulative Limt (lb/acre)				*permit*	125	
	Land Needed				loading / limit	0.000	
	Site Life				lb/Acre/permit	**10155**	**Years**
Lead *	mg/L	*mg/Gal*	lb/Gal	*Flow*	Mass Applied	lb/Acre	
	0.01	0.03785	8.34593E-08	500000	0.041729625	0.01	
	Cumulative Limt (lb/acre)				*permit*	1000	
	Land Needed				loading / limit	0.000	
	Site Life				lb/Acre/permit	**81237**	**Years**
Cadmium *	mg/L	*mg/Gal*	lb/Gal	*Flow*	Mass Applied	lb/Acre	
	0.0025	0.0094625	2.08648E-08	500000	0.010432406	0.00	
	Cumulative Limt (lb/acre)				*permit*	8.9	
	Land Needed				loading / limit	0.001	
	Site Life				lb/Acre/permit	**2892**	**Years**

* Ni, Pb and Cd were not analysed during routine monitoring therefore historic data was utilized. These elements are not anticiapated in the waste stream. Data from the 2002 application renewal and a total flow of 500,000 gallons was utilized for these calculations.

Aresnic ** < 5 ug/L (not a land limiting parameter)

Boron ** 0.39 mg/L (not a land limiting parameter)

** Arsenic and Boron were not analysed during routine monitoring therefore historic data was utilized. These elements are not anticiapated in the waste stream.

VPA 01044

Available land	3.39
2009 total Flow	0.22

HYDRAULIC LOADING

2009 Weather Data
from wunderground.com

			JUL	AUG	SEP
P	in/month		8.82	7.14	7.36
ET	in/month		5.87	5.9	2.36
Net P	in/month		2.95	1.24	5
Perc *	in/month		17.850	17.850	17.280
Max Application		in/week	0.380	0.390	0.390
		in/day	0.008	0.007	0.006
Allowable loading		in/month	19.786	18.406	17.690
Actual max loading		in/week	0.380	0.390	0.390
Estimated Max Flow				5000	GPD
				35000	gal / week
				4679.01	cf / week
				1.29	in / week
Permit				2	in / week
Required land based on hydraulic loading				**0.64**	**Acres**

* 0.6 in/hr.

Note #1 (C-I.4 #3.c)
This is not a new facility; it was previously operated for tomato processing using the same equipment and general process. The facility owner has changed, necessitating a new permit, and the vegetable type has changed to potato. The process is similar but the disinfectant (chlorine dioxide) used in washing is different. The disinfectant is not added to the flume wash water but is only applied to the potatoes after washing.

Data included on the table is from vegetable processing operations at this facility in 2009. New data from potato processing operations will be provided as it becomes available.

Note #2 (C-I.7 #5)
Figure 2 is a schematic and line drawing of the facility and process. Approximately 2,500-gallons of wastewater (used flume wash water) will be generated per day. Waste wash water will be conveyed to a series of two (2) 6,000-gallon holding tanks utilizing a 200-gpm transfer pump. The 12,000 gallons of storage capacity provides nearly 5 days worth of detention time that will allow any sediments or solids in the wastewater to settle prior to field application.

Wastewater will be transferred from the storage tank into the spray truck by a 48-gpm transfer pump. The spray truck will drive along 7 parallel lines (A-G on Figure 4) to discharge the wash water. The cumulative application rate along each line will not exceed 1"/day, or as directed by the permit. The application rate will be pre-determined by recording the amount of discharge applied over a given area for a specific truck speed and that speed will be maintained during each application. Wastewater is sequentially applied to each section to ensure uniform coverage.

Full Parameter List

Chemical	Components	Concentrations
Macho 2.0FL Insecticide	Imidacloprid	To be provided
Vydate	Oxamyl, methanol	To be provided
Early Harvest	Cytokinin, Indole Butyric Acid, Gibberellic Acid	To be provided
Ultra Flourish	Mefenoxam, Petroleum Distillates, Napthalene, 1,2,4 Trimethylbenzene, Cumene	To be provided
Quadris	Propylene Glycol, Azoxystrobin	To be provided
Regent	fipronil	To be provided
Manzate	Mancozeb, ethylene thiourea	To be provided
Bravo Ultra	chlorothalonil	To be provided
Curzate DF 60	Cymoxanil	To be provided
Dual Magnum	Petroleum solvent, 1,2,4-trimethylbenzene, naphthalene, s-metolachlor	To be provided
Sencore	Metribuzin, sodium aluminum silicate, quartz, crystalline quartz	To be provided
Intensity one	Clethodim, xylene, naphthalene	To be provided
Matrix	rimsulfuron	To be provided
Reglone	Diquat dibromide	To be provided
Aim	Naphtha, carfentrazone-ethyl, 2-methylnaphthalene, propylene glycol, xylenes, naphthalene, 1-methylnaphthalene	To be provided
Asana XL	Esfenvalerate, ethylbenzene	To be provided
Round up	glyphosate	To be provided
Rimon	n-methyl-2-pyrrolidone, novaluron	To be provided
Selectrocide	Chlorine dioxide (gas)	To be provided

* Nothing added to wash water. No sodium hypochlorite is used. Chlorine dioxide (Selectrocide) is sprayed to disinfect product after washing and some may drain back or otherwise get into flume washwater. The chemical substances listed are from the products MSDS.

Material Safety Data Sheet

May be used to comply with
OSHA's Hazard Communication Standard,
29 CFR 1910.1200. Standard must be
Consulted for specific requirements.

U.S. Department of Labor

Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY *(As Used on Label and List)*	Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.
Selecticide-Germicide	

Section I

Manufacturer's Name Selected Chemical Products Company, Inc. DBA Selected Beauty Products Company	Emergency Telephone Number Infortrac 1-800-535-5053
Address *(Number, Street, City, State, and ZIP Code)*	Telephone Number for Information (847) 623-2224
2649 DELANY ROAD	Date Prepared September 1, 2007
WAUKEGAN, IL 60087	Signature of Preparer *(optional)*

Section II - Hazard Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity, Common Name(s))	OSHA PEL Unk	ACGIH TLV Unk	Other Limits Recommended	%*(optional)*
This product was produced using approved Industry components.				
Using this product according to intended purpose and directions should generally be considered safe.				
If ingestion or exposure to eyes occur, consult a physician. If a reaction or rash develops, discontinue use immediately.				
Hazardous components found in this product are:				
Alkyl Dimethyl Benzyl Ammonium Chloride (5%) – CAS# 68391-01-5				
Alkyl Dimethyl Ethylbenzyl ammonium chloride Case # 68956-79-6				

Section III - Physical/Chemical Characteristics

Boiling Point	210° F	Specific Gravity (H_2O = 1)	1.0
Vapor Pressure (mm Hg.)	Like Water	Melting Point	Not Determined
Vapor Density (AIR = 1)	Like Water	Evaporation Rate (Butyl Acetate = 1)	Like water
Solubility in Water Yes			
Appearance and Odor Dark Green – Slight Pungent Odor			

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used) Not Determined	Flammable Limits N/A	LEL N/A	UEL N/A
Extinguishing Media Dry Chemical Foam, CO_2 - Water			
Firefighters should wear protective clothing and breathing apparatus.			
Unusual Fire and Explosion Hazards - None			

APPENDIX F
References

Accomack County, Virginia

BkA—Bojac sandy loam, 0 to 2 percent slopes

Map Unit Setting

Elevation: 10 to 250 feet
Mean annual precipitation: 25 to 60 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 200 to 220 days

Map Unit Composition

Bojac and similar soils: 90 percent

Description of Bojac

Setting

Landform: Terraces
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Marine sediments

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.9 inches)

Interpretive groups

Farmland classification: All areas are prime farmland
Land capability (nonirrigated): 1
Hydrologic Soil Group: A

Typical profile

0 to 7 inches: Sandy loam
7 to 40 inches: Loam
40 to 85 inches: Sand

Data Source Information

Soil Survey Area: Accomack County, Virginia
Survey Area Data: Version 11, Dec 11, 2013

Accomack County, Virginia

BhB—Bojac loamy sand, 2 to 6 percent slopes

Map Unit Setting

Elevation: 10 to 250 feet
Mean annual precipitation: 25 to 60 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 200 to 220 days

Map Unit Composition

Bojac and similar soils: 90 percent

Description of Bojac

Setting

Landform: Terraces
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Marine sediments

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.5 inches)

Interpretive groups

Farmland classification: All areas are prime farmland
Land capability (nonirrigated): 2e
Hydrologic Soil Group: A

Typical profile

0 to 7 inches: Loamy sand
7 to 40 inches: Loam
40 to 85 inches: Sand

Data Source Information

Soil Survey Area: Accomack County, Virginia
Survey Area Data: Version 11, Dec 11, 2013

ATTACHMENT C-1a
DEPARTMENT OF ENVIRONMENTAL QUALITY
Virginia Pollution Abatement Monitoring Report

Facility Name: Taylor and Fulton, Incorporated
Address: P.O. Box 76
Mappsville, VA 23407

VPA Permit No.: VPA01044 **Annual Report, All values are Calculated based on previously submitted reports**

Report Period: From 1/1/2009 To 12/31/2009

Monitoring Station: **Spray Irrigation Wastewater From Storage Tank**

Parameters	Units		Monitoring Results		Analysis Frequency	Sample Type
			Average	Maximum		
Flow	MGD	Reported	0.0040	5616.0000	*1/Day*	*Measured*
		Required	NL	NL	1/Day	Measured
Total Vol. Applied	MG	Reported		0.219017	*Monthly*	*Calculated*
		Required	*****	NL	Monthly	Calculated
Application Rate	in/day	Reported		5616.00	*1/App. Day*	*Measured*
		Required	*****	1.0	1/App. Day	Measured
Application Rate	in/wk.	Reported		0.39	*1/Week*	*Measured*
		Required	*****	2.0	1/Week	Measured
PH	S.U.	Reported	6.80	8.15	*2/Month*	*Grab*
		Required	6.0 min	9.0	2/Month	Grab
Chlorides	mg/l	Reported	285.67	550.00	*2/Month*	*Grab*
		Required	NL	NL	2/Month	Grab
TKN	mg/l	Reported	18.83	70.50	*2/Month*	*Grab*
		Required	NL	NL	2/Month	Grab
TKN	#/acre	Reported	1.82	8.82	*2/Month*	*Calculated*
		Required	NL	NL	2/Month	Calculated
Nitrate-Nitrogen	mg/l	Reported	1.13	2.50	*2/Month*	*Grab*
		Required	NL	NL	2/Month	Grab
Nitrate-Nitrogen	#/acre	Reported	0.11	0.46	*2/Month*	*Calculated*
		Required	NL	NL	2/Month	Calculated
Ammonia-Nitrogen	mg/l	Reported	6.88	36.10	*2/Month*	*Grab*
		Required	NL	NL	2/Month	Grab
Ammonia-Nitrogen	#/acre	Reported	0.72	4.14	*2/Month*	*Calculated*
		Required	NL	NL	2/Month	Calculated
Available Phosphorus	mg/l	Reported	3.77	7.20	*2/Month*	*Grab*
		Required	NL	NL	2/Month	Grab

Name of Principal Exec. Officer or Authorized Agent / Title

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations. See 18 U.S.C. ?1001 and 33 U.S.C. ?1319. (Penalties under these statutes may include fines up to $10,000 and or maximum imprisonment of between 6 months and 5 years.)

Signature of Principal Officer or Authorized Agent / Date

ATTACHMENT C-1a
DEPARTMENT OF ENVIRONMENTAL QUALITY
Virginia Pollution Abatement Monitoring Report

Facility Name: Taylor and Fulton, Incorporated
Address: P.O. Box 76
Mappsville, VA 23407

VPA Permit No.: VPA01044 **Annual Report, All values are Calculated based on previously submitted reports**

Report Period: From / / / /2009 To /2/3 1/2009

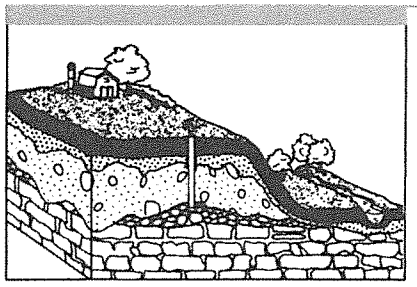
Monitoring Station: **Spray Irrigation Wastewater From Storage Tank**

Parameters	Units		Monitoring Results		Frequency of Analysis	Sample Type
			Average	Maximum		
Available Phosphorus	#/acre	Reported	0.35	1.06	*2/Month*	*Calculated*
		Required	NL	NL	2/Month	Calculated
Available Potassium	mg/l	Reported	38.90	76.20	*2/Month*	*Grab*
		Required	NL	NL	2/Month	Grab
Available Potassium	#/acre	Reported	3.92	16.07	*2/Month*	*Calculated*
		Required	NL	NL	2/Month	Calculated
Calcium	mg/l	Reported	83.40	298.00	*2/Month*	*Grab*
		Required	NL	NL	2/Month	Grab
Magnesium	mg/l	Reported	12.92	25.98	*2/Month*	*Grab*
		Required	NL	NL	2/Month	Grab
Electro-Conduct (EC)	dS/m	Reported	1431.17	3265.00	*2/Month*	*Grab*
		Required	NL	NL*	2/Month	Grab
Dissolved Copper	ug/l	Reported	638.33	1206.00	*2/Month*	*Grab*
		Required	NL	NL	2/Month	Grab
Dissolved Zinc	ug/l	Reported	341.17	1130.00	*2/Month*	*Grab*
		Required	NL	NL	2/Month	Grab
PAN	#/acre	Reported		3.92	*1/Month*	*Calculated*
		Required	NA	Attch C*	1/Month	Calculated
PAN	#/acre /year	Reported		21.55	*1/Year*	*Calculated*
		Required	NA	Attch C*	1/Year	Calculated
Sodium	mg/l	Reported	321.25	974.70	*2/Month*	*Grab*
		Required	NL	NL	2/Month	Grab
SAR	meq/l	Reported	9.32	36.84	*2/Month*	*Calculated*
		Required	NL	NL	2/Month	Calculated
Pesticide Scan (608) Freeboard	ug/l	Reported	*Attach pages*	*Attach pages*	*1/year*	*Grab*
		Required	NA	NL	1/year	Grab

Name of Principal Exec. Officer or Authorized Agent / Title

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations. See 18 U.S.C. ?1001 and 33 U.S.C. ?1319. (Penalties under these statutes may include fines up to $10,000 and or maximum imprisonment of between 6 months and 5 years.)

Signature of Principal Officer or Authorized Agent / Date



Soil Facts

Nutrient Removal by Crops in North Carolina

Studying nutrient removal by plants is one of the methods used to develop fertility recommendations. Tests are designed to examine patterns of nutrient uptake in response to different levels of fertilizer application. Information on nutrient removal alone is not adequate for making fertility recommendations because it does not take into account the ability of the soils to retain and supply nutrients. It can, however, show variations in nutrient needs among different crops. In addition, it can indicate the rates at which reserves of soil nutrients will be depleted.

Plant growth and development depends on many factors, including adequate nutrition. The exact amount of fertilizer necessary varies with the potential yield, growth, and the concentration of nutrients that are available from soil reserves and decaying organic matter. These interacting factors make it difficult to develop reliable recommendations for fertility. Sound recommendations require well-planned, long-term experiments that can show responses for a wide range of environmental, soil, and growth conditions.

Nutrients in plants that are left in the field will partially resupply nutrient reserves in the soil as they decompose. Estimates of nutrient depletion, therefore, should take into account only the nutrients removed with the harvested portion of the plant. The table on page 2 shows the mean concentration of various nutrients that are removed by each crop for the yield level indicated. Values are not reported for boron, molybdenum, iron, or chlorine because they were omitted from the references used. This does not mean they are not removed nor that they are unimportant. A brief discussion of each nutrient precedes the table.

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Nitrogen

Nitrogen is a part of all plant and animal proteins and a component of DNA and RNA. Crop uptake of nitrogen is relatively inefficient and often results in average nitrogen losses of 50 percent because of leaching, volatilization, or denitrification. Consequently, crop removal values reflect a minimum amount of nitrogen required because they do not account for nitrogen losses.

Legumes produce most of their own nitrogen through a symbiotic, or beneficial, relationship with bacteria (Rhizobium species) that infect their roots. These bacteria have the ability to convert atmospheric nitrogen into forms that can be used by plants. Therefore, legumes with active nitrogen-fixing bacteria do not need additional sources of nitrogen. If fertilizer nitrogen is added to a legume, bacterial production of nitrogen decreases. Current research suggests that legumes may be less efficient than nonlegume crops in recovering nitrogen applied as fertilizers.

Nitrogen can accumulate under some conditions in North Carolina soils. However, the rate of accumulation and the length of availability is extremely unpredictable and as such is not included in standard soil analysis. Sources of soil nitrogen include commercial fertilizers, animal manures, legume residues, and other forms of decaying organic matter. For more information on nitrogen refer to Extension publication AG-439-2 *Nitrogen Management and Water Quality.*

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Table 1. Estimated Nutrient Removal Rates of Crops

Crop		Yield per acre	N	P_2O_5	K_2O	Ca	Mg	S	Cu	Mn	Zn
			lbs								
Grains											
Barley	(grain)	40 bu	35	15	10	1	2	3	0.03	0.03	0.06
	(straw)	1 ton	15	5	30	8	2	4	0.01	0.32	0.05
Corn	(grain)	150 bu	135	66	40	2	8	10	0.06	0.09	0.15
	(stover)	4.5 tons	100	37	145	26	20	14	0.05	1.50	0.30
Oats	(grain)	80 bu	50	20	15	2	3	5	0.03	0.12	0.05
	(straw)	2 tons	25	15	80	8	8	9	0.03	—	0.29
Rye	(grain)	30 bu	35	10	10	2	3	7	0.02	0.22	0.03
	(straw)	1.5 tons	15	8	25	8	2	3	0.01	0.14	0.07
Sorghum	(grain)	60 bu	50	27	15	4	5	5	0.01	0.04	0.04
	(stover)	3 tons	65	20	95	29	18	—	—	—	—
Wheat	(grain)	40 bu	50	20	15	1	6	3	0.03	0.09	0.14
	(straw)	1.5 tons	20	5	35	6	3	5	0.01	0.16	0.05
Hay											
Alfalfa		4 tons	180	59	180	112	21	19	0.06	0.44	0.42
Bluegrass		2 tons	60	29	60	16	7	5	0.02	0.30	0.08
Coastal Bermuda		8 tons	400	92	345	48	32	32	0.02	0.64	0.48
Cowpea		2 tons	120	25	80	55	15	13	—	0.65	—
Fescue		3.5 tons	135	65	185	—	13	20	—	—	—
Orchardgrass		6 tons	300	100	375	—	25	35	—	—	—
Red Clover		2.5 tons	100	25	100	69	17	7	0.04	0.54	0.36
Ryegrass		5 tons	215	85	240	—	40	—	—	—	—
Sorghum-Sudan		8 tons	319	122	467	—	47	—	—	—	—
Soybean		2 tons	90	20	50	40	18	10	0.04	0.46	0.15
Timothy		2.5 tons	60	25	95	18	6	5	0.03	0.31	0.20
Fruits and Vegetables											
Apples		500 bu	30	10	45	8	5	10	0.03	0.03	0.03
Beans, dry		30 bu	75	25	25	2	2	5	0.02	0.03	0.06
Bell Peppers		250 cwt	137	52	217	—	43	—	—	—	—
Broccoli†		1 cwt	.58	0.18	0.44	—	—	—	—	—	—
Cabbage		15 tons	98	27	98	15	6	33	.03	.08	0.06
Cucumbers		10 tons	90	28	174	—	25	—	—	—	—
Eggplant‡		16 tons	207	46	34	—	—	—	—	—	—
Lettuce‡		7 tons	61	19	116	13	4	—	—	—	—
Melons	(cantaloupe)†	10 cwt	1.5	0.84	3.84	—	—	—	—	—	—
	(honeydew)†	10 cwt	1.06	0.44	3.61	—	—	—	—	—	—
	(watermelon)‡	6 tons	50	14	89	63	13	—	—	—	—

Table 1. *(continued)*

Crop		Yield per acre	N	P_2O_5	K_2O	Ca	Mg	S	Cu	Mn	Zn
			lbs								
Okra‡		8 tons	179	65	139	24	24	—	—	—	—
Onions		12 tons	28	12.5	25	6.9	1	11	0.02	0.05	0.19
Peaches		600 bu	35	20	65	4	8	2	—	—	0.01
Peas		25 cwt	164	35	105	—	18	10	—	—	—
Potatoes	(white)	30,000 lbs	90	45	158	5	7	7	0.06	0.14	0.08
	(vines)	—	61	20	54	—	12	7	—	—	—
Potatoes	(sweet)	500 bu	67	57.5	160	7	7	10	0.03	0.10	0.05
	(vines)	—	30	4	280	—	5	—	—	—	—
Snap Beans		4 tons	138	33	163	—	17	—	—	—	—
Spinach		5 tons	50	10	30	12	5	4	0.02	0.10	0.10
Squash	(summer)**	10 tons	32	12	56	—	—	—	—	—	—
	(winter)*	6 tons	12	10	58	—	—	—	—	—	—
Sweet Corn		90 cwt	140	47	136	—	20	11	—	—	—
Tomatoes		20 tons	120	20	160	7	11	14	0.07	0.13	0.16
Turnips		15 tons	45	20	90	12	6	—	—	—	—
Other Crops											
Cotton	(seed & lint)	2,600 lbs	63	25	31	4	7	5	0.18	0.33	0.96
	(stalks, leaves, & burs)	3,000 lbs	57	16	72	56	16	15	0.05	0.06	0.75
Peanuts	(nuts)	4,000 lbs	140	22	35	6	5	10	0.04	0.3	0.25
	(vines)	5,000 lbs	100	17	150	88	20	11	0.12	0.15	—
Soybeans	(beans)	50 bu	188	40	74	19	10	23	0.05	0.06	0.05
	(leaves, stems, & pods)	6,100 lbs	89	16	74	30	9	12	—	—	—
Tobacco, flue-cured											
	(leaves)	3,000 lbs	85	15	155	75	15	12	0.03	0.55	0.07
	(stalks)	3,600 lbs	41	11	102	—	9	7	—	—	—
Tobacco, burley											
	(leaves)	4,000 lbs	145	17	150	—	18	24	—	—	—

(—) symbol means the information was not available in the reference used.
†USDA, NRCS. 2007. The PLANTS Database (http://plants.usda.gov, 19 November 2007). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.
‡Wichmann, W. (ed.), 2007. World Fertilizer Use Manual (http://www.fertilizer.org/ifa/publicat/html/pubman/manual.htm, 19 November 2007). BASF AG, Germany.
*Schulthers, J.R., 1995. Growing Pumpkins and Winter Squash (http://www.ces.ncsu.edu/depts/hort/hil/hil-24.html).
**Smith, R.C., 2000. Vegetable Maturity Dates, Yield and Storage, H-912. (http://www.ag.ndsu.edu/pubs/plantsci/hortcrop/h912w.htm).
Other reference sources include: The Fertilizer Institute, Potash and Phosphate Institute, Alabama CES circular ANR-449, Tisdale and Nelson's *Soil Fertility and Fertilizers*, Mortvedt, Giordano and Lindsay's *Micronutrients in Agriculture*, and IMC's *Efficient Fertilizer Use — Fertilizing for Profit*.

Phosphorus

Phosphorus is involved in the energy dynamics of plants. Without it, plants could not convert solar energy into the chemical energy needed for the synthesis of sugars, starches, and proteins. Phosphorus moves very slowly in mineral soils and thus tends to build up over time when the amount of phosphorus added in fertilizer and organic matter exceeds the amount removed in the harvested portions of crops. Because phosphorus is relatively immobile in soil, it is important that plant roots have a close and adequate supply. Factors that inhibit root growth therefore can affect uptake of phosphorus.

Much of the phosphorus added to soil is "fixed" by chemical reactions with iron, aluminum, and calcium and becomes unavailable for uptake by crops. The quantity of phosphorus available to plants is much smaller than the total quantity of phosphorus in the soil. This amount can be determined only through soil tests. The quantity of available phosphorus in soils is the fraction that is affected by plant uptake.

Potassium

Potassium is involved in photosynthesis, sugar transport, water and nutrient movement, protein synthesis, and starch formation. Potassium helps to improve disease resistance, tolerance to water stress, winter hardiness, tolerance to plant pests, and uptake efficiency of other nutrients.

Potassium removal by crops under good growing conditions is usually high, and is often three to four times that of phosphorus and equal to that of nitrogen. In many cases where levels of soluble potassium in the soil are high, plants tend to take up more potassium than they need. This is called luxury consumption because the excess potassium does not increase yields.

Potassium is also mobile in soils, depending on soil texture. Movement is greatest in course-textured sands, followed by fine sands and then clay soils. Accumulation of potassium also depends upon soil texture. The greatest accumulation generally occurs in clay soils, followed by loam and coarse-textured sands.

Calcium and Magnesium

Calcium is a constituent of the cell wall and keeps the cell membranes stable. Visual evidence of calcium deficiencies generally occurs in growing points of the plant at the fruit, stem, leaf, and root tips.

Magnesium is an essential part of the chlorophyll molecule where photosynthesis occurs. Magnesium is also involved in energy metabolism in the plant and is required for protein formation.

Depletion of calcium and magnesium reserves in the soil by crop removal is rarely a problem in limed soils because of the large quantity of these nutrients that are present in liming materials. However, some crops, such as peanuts, may require more calcium than the crops can remove.

Sulfur

Sulfur is a component of some amino acids that are important in building proteins. Sulfur is required by plants in about the same quantity as phosphorus.

Sulfur, just as nitrogen, is mobile in soils and can be lost by leaching. Leaching is greatest in coarse-textured soils under high rainfall conditions and least in limed clay soils that are low in aluminum and iron. In North Carolina, most of the sulfur in surface soils is associated with organic matter. About 10 pounds of sulfur per acre are deposited annually by rainfall in North Carolina. Values for crop removal may be useful guides for sulfur fertilization on coarse-textured, sandy soils with clay subsoils at depths greater than 15 inches.

Micronutrients

Micronutrients are called "micro" only because they are needed in very small quantities by plants. Without them, however, no plant could survive and function normally. The micronutrients are involved in different plant processes and can react differently in the soil.

Copper. Copper is involved in plant enzyme systems, protein synthesis, seed formation, chlorophyll formation and nitrogen metabolism. Copper moves very little in soils and thus can accumulate when application rates exceed utilization. Copper is also held tightly by organic matter.

Zinc. Zinc is involved in starch formation, protein synthesis, root development, growth hormones, and enzyme systems. As with copper, zinc is relatively immobile in soils and tends to accumulate.

Manganese. Manganese is involved in chlorophyll formation, nitrate assimilation, enzyme systems, and iron metabolism. Manganese deficiency is generally caused by a high soil pH but can also be induced by an imbalance with other elements such as calcium, magnesium, and ferrous iron. Manganese availability in limed soils is decreased with increasing levels of organic matter.

Boron. Boron is involved in sugar and starch balance and translocation, pollination and seed production, cell division, nitrogen and phosphorus metabolism, and protein formation. Boron, just as nitrogen and sulfur, is highly mobile and is not readily retained by sandy surface soils. Because of this mobility, boron must be added annually for crops sensitive to boron deficiencies. Removal of boron by crops is a reasonable estimate of need. Leaching loss of boron is typically several times greater than crop removal. Boron fertilizer is re-

quired for cotton, peanuts, reseeding clovers, and alfalfa, and vegetable crops often require boron fertilization on sandy soils.

Molybdenum. Molybdenum is involved in protein synthesis, legume nitrogen fixation, enzyme systems, and nitrogen metabolism. Deficiencies of molybdenum generally occur on acidic soils that contain high levels of iron and aluminum oxides. Estimates of molybdenum removal by crops may serve as a general fertilization guide. However, availability of soil reserves of molybdenum to the plant are largely regulated by soil pH.

Iron. Iron is important in chlorophyll and protein formation, enzyme systems, respiration, photo-synthesis, and energy transfer. Iron deficiency, which is not very common in North Carolina, is believed to be caused by an imbalance of metallic ions, such as copper and manganese, excessive amounts of phosphorus in soils, and a combination of high pH, high lime, cool temperatures and high levels of carbonate in the root zone.

Chlorine. Chlorine is involved in photosynthesis, water-use efficiency, crop maturity, disease control and sugar translocation. While chloride leaches quite readily in coarse-textured soils, deficiencies are not very common.

Summary

Estimates of crop nutrient removal rates are useful in comparing the nutrient demands of different crops. These values, however, do not take into account the quality and availability of nutrient reserves already in the soil. Because of this limitation, soil testing should still be the cornerstone of all fertility programs. Removal rates can be used in conjunction with soil testing to estimate nutrient reserves.

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E08—RM-H

POTENTIAL EVAPOTRANSPIRATION CALCULATIONS
[Thornthwaite, 1948]

Month	Air Temp (Avg °C/Day)	Sunshine Factor [b]	**P.E.T. (cm)**	Heat Index (by month)
JAN	2	0.86	0.19	0.25
FEB	4	0.84	0.56	0.71
MAR	10	1.03	2.96	2.85
APR	13	1.1	4.80	4.23
MAY	16	1.22	7.42	5.79
JUN	23	1.23	13.35	10.02
JUL	24.4	1.25	14.91	10.95
AUG	25.5	1.17	14.97	11.71
SEP	15.5	1.035	5.98	5.52
OCT	22	0.965	9.76	9.37
NOV	14	0.85	4.18	4.73
DEC	12	0.83	3.19	3.75
Annual Potential Evapotranspiration =			**82.26**	69.89 = ANNUAL HEAT INDEX

PET = 1.62b [10T/I] ^{a}

b = sunshine factor [mean possible hours of bright sunlight (30days/12hrs)]
T = mean monthly air temperature (°C)
I = annual Heat Index
a = empirical coefficient

Air Temp = Average daily temperature at Melfa, Virginia over the last 9 years.

cm to inch ocnversion (X/2.54)	
JUL	5.87
AUG	5.90
SEP	2.36
Total	14.12

EVAPOTRANSPIRATION

The combined water losses from evaporation and vegetative transpiration are termed evapotranspiration (ET). Evaporation is relatively easy to measure using evaporative pan data, however transpiration is difficult to quantify without direct field measurements. Actual ET losses from a site are most readily estimated through calculation. The thickness (relative depth) of soil water loss through ET can, however, be empirically determined. When this thickness is multiplied by an area, a volume of water loss may be calculated.

Thornthwaith (1948) developed a relationship for monthly potential evapotranspiration (PET) based on an a heat index and empirical coefficients for available sunshine and crop transpiration. Braas (1990) simplified the equation to:

$$PET = 1.62b \times [10T/I]^a$$

where, b is an adjustment factor for daily available sunshine, T is the mean monthly temperature (°C), I is the annual heat index, and a is a relative parameter based on I.

The Thornthwaite approach assumes that the soil water available for ET is not limited. Therefore, this calculation yields potential evapotranspiration (PET) which is an estimation of a maximum thickness of soil water loss.

Results of the PET calculations estimate the monthly relative thickness of water loss. These monthly thicknesses were multiplied by the area of the YYYYYY (Z.ZZ ac,ft^2) and the resultant volumes added together to calculate the approximate annual volume of its' evapotranspirative losses. The total estimated annual volume of water loss through PET at YYYYYYY YYYYYYY is ZZ.ZZ gal/ft^3. A data listing and monthly breakdown of PET quantities is provided *******.

Braas, R.L., 1990. Hydrology: an introduction to hydrologic science. New York: Addison-Wesley Publishing Company. pp 224-225.

Thornthwaite, C.W., 1948. An approach toward a rational classification of climate. *Am. Geogr. Rev.* 38:55-94

Item 2

Please submit this completed form with your application
Maintenance fee billing will be sent using this information

Permit Maintenance Fee Information

(1) Facility Name: Kuzzens - Mappsville North Packing Plant
(Please indicate all facility names applicable for the information listed below)

(2) Permit Number(s):
VPA 01044
(Please indicate all VPDES individual permit numbers applicable for the information listed below)

(3) Tax Payer ID [FIN]: 59-0709966

(4) Billing Information:

Corporate Name or Owner Name Kuzzens, Inc.

Corporate Billing Address or Owner Address: 3769 Grapeland Circle
Exmore, Virginia 23350

(5) Billing Contact:

Name, Title: Gerry ODell,

Phone Number: (757) 442-4961

E-mail Address: godell@sixls.com

AUTHORIZATION TO BILL APPLICANT FOR A PUBLIC NOTICE FOR KUZZENS- MAPPSVILLE NORTH PACKING PLANT Accomack Co., VA PREVIOUSLY PERMIT VPA01044

I hereby authorize the Department of Environmental Quality to have the cost of publishing a public notice billed to the Agent/Department shown below. The public notice will be published once a week for two consecutive weeks in the: **EASTERN SHORE NEWS**

Agent/Department to be billed: Mr. Richard W. Davis, Farm Manager

Kuzzens, Inc.

Applicant's Address: 3769 Grapeland Circle

Exmore, VA 23550

Agent's Telephone No: 757-442-4961

I AM ALSO AUTHORIZING THE EASTERN SHORE NEWS TO SEND THE AFFIDAVIT TO:

DEQ TIDEWATER REGIONAL OFFICE
WATER PERMITS
5636 SOUTHERN BOULEVARD
VIRGINIA BEACH, VA 23462

Authorizing Agent/Date Signed: Richard Davis 3/10/14
Print

Name/Date Signed

Authorizing Agent's Signature: Davis
Signature

Authorizing Agent's E-Mail Address: Richard.davis@lipmanproduce.com

RETURN COMPLETED FORM TO: DEQ – Tidewater Regional Office
Attn: Colleen Porter-Water Permits
5636 Southern Boulevard
Virginia Beach, VA 23462

Cc: **(DEQ FILE ECM)**